AQA GCSE Chemistry

# The rate and extent of chemical change · Foundation tier

Questions only

The newest questions on the Foundation papers, about an hour. All 8 are in the exam generator.

| Questions | Total marks | Time allowed |
|---|---|---|
| **6** | **54** | **57 min** |

Name _____ Class or teacher _____ Date _____

**Instructions**

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the periodic table insert.
- Print the separate mark scheme when you are ready to mark your answers.

**For marking**

| Q | Source | Marks | Score |
|---|---|---|---|
| 1 | 2022 P2F Q6 | 8 | |
| 2 | 2022 P2F Q9 / P2H Q2 | 8 | |
| 3 | 2023 P2F Q4 | 9 | |
| 4 | 2023 P2F Q8 / P2H Q1 | 10 | |
| 5 | 2024 P2F Q5 | 11 | |
| 6 | 2025 P2F Q3 | 8 | |

**Total** _____ / 54 **Percentage** _____ %

Questions from AQA GCSE past papers, 2022–2025, reproduced for revision. Practise these topics online, with instant marking: `whiteboardchemistry.com/revision/gcse-chemistry/exam-questions?topics=c6-rates-equilibrium&demand=low,standard&len=0`

# Questions

The rate and extent of chemical change · Foundation tier · 6 questions · 54 marks · time allowed 57 min

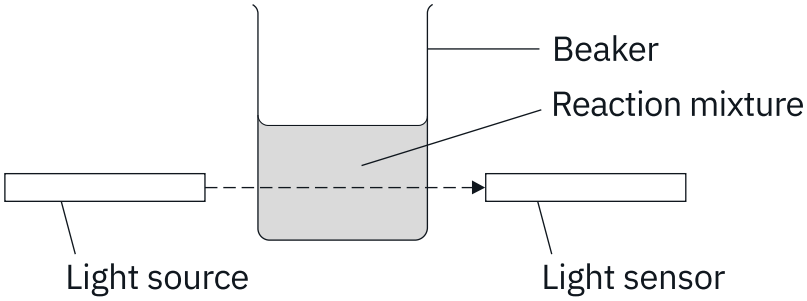
**Q1 · June 2022 · Paper 2 Foundation · Q6 · [8 marks]**

This question also needs Atomic structure and the periodic table, Bonding, structure, and the properties of matter and Quantitative chemistry.

A student investigated the rate of reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 7 shows the apparatus used.

Figure 7




When hydrochloric acid is added to sodium thiosulfate solution, the mixture gradually becomes cloudy.

A smaller percentage of light from the light source reaches the light sensor as the mixture becomes more cloudy.

This is the method used.

1. Measure 50 $cm^3$ of sodium thiosulfate solution into the beaker.

2. Add 10 $cm^3$ of hydrochloric acid to the sodium thiosulfate solution.

3. Immediately start a timer.

4. Record the percentage of light from the light source that reaches the light sensor every 20 seconds for 120 seconds.

**06.1** Balance the equation for this reaction.

$Na_2S_2O_3 + 2HCl \rightarrow$ _____ $NaCl + H_2O + SO_2 + S$

**[1 mark]**

**06.2** The mixture becomes cloudy because the sulfur produced is a solid.

What is the state symbol for a solid?

Tick (✓) **one** box.

| | |
|---|---|
| (aq) | ☐ |
| (g) | ☐ |
| (l) | ☐ |
| (s) | ☐ |

**[1 mark]**

**06.3** The student monitored the cloudiness of the reaction mixture using a light sensor.

What other piece of equipment could be used to monitor the cloudiness of the reaction mixture?

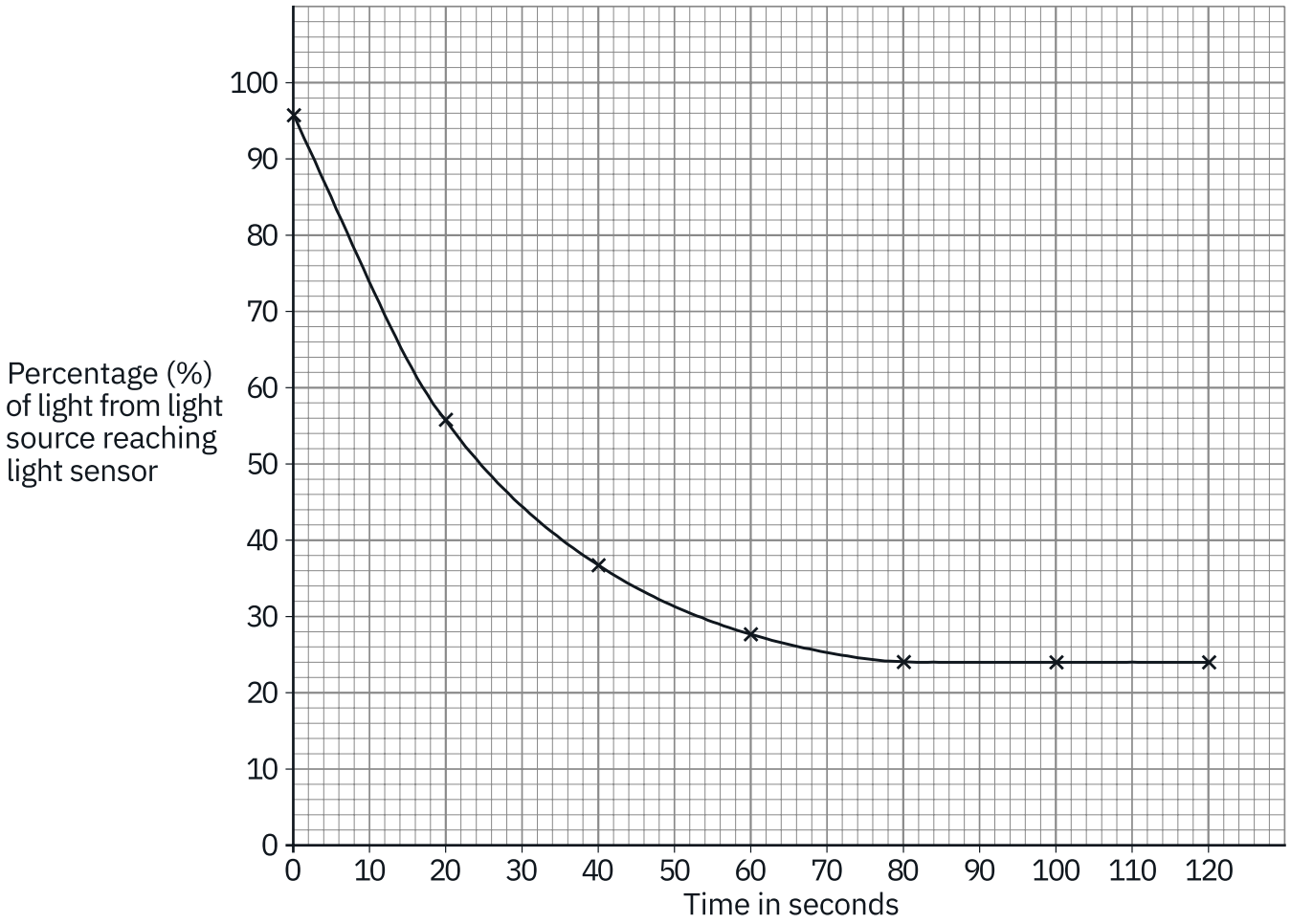
Tick (✓) **one** box.

| | |
|---|---|
| A balance | ☐ |
| A cross on a piece of paper | ☐ |
| A gas syringe | ☐ |
| A thermometer | ☐ |

**[1 mark]**

**06.4** Figure 8 shows the results.

Figure 8




What happened to the rate of reaction between 40 and 60 seconds?

Use Figure 8.

Tick (✓) **one** box.

| | |
|---|---|
| The rate of reaction decreased. | ☐ |
| The rate of reaction stayed at zero. | ☐ |
| The rate of reaction increased. | ☐ |

**[1 mark]**

**06.5** The student stopped taking measurements after 120 seconds because the percentage of light reaching the sensor stayed constant.

Why did the percentage of light reaching the sensor stay constant?

Tick (✓) **one** box.

| | |
|---|---|
| No light was reaching the sensor. | ☐ |
| One of the reactants was used up. | ☐ |
| The reaction was too vigorous. | ☐ |

**[1 mark]**

**06.6** The student repeated the experiment using sodium thiosulfate solution of a higher concentration.

How would the line of best fit for sodium thiosulfate solution of a higher concentration compare with the line of best fit on Figure 8?

Tick (✓) **one** box.

| | |
|---|---|
| Initially the line of best fit would be less steep. | ☐ |
| Initially the line of best fit would be the same steepness. | ☐ |
| Initially the line of best fit would be steeper. | ☐ |

**[1 mark]**

**06.7** The student then investigated the effect of changing the temperature on the rate of reaction.

The student used sodium thiosulfate solution and hydrochloric acid which had been kept in an ice bath.

Which are **two** effects of using reactants kept in an ice bath rather than at room temperature?

Tick (✓) **two** boxes.

| | |
|---|---|
| Fewer reactant particles have the activation energy. | ☐ |
| The reactant particles collide more frequently. | ☐ |
| The reactant particles have more energy. | ☐ |
| The reactant particles move more slowly. | ☐ |
| There are fewer reactant particles in the same volume. | ☐ |

**[2 marks]**

**Q2 · June 2022 · Paper 2 Foundation · Q9 · Paper 2 Higher · Q2 · [8 marks]**

This question also needs Quantitative chemistry.

A student investigated the change in mass when hydrated cobalt chloride was heated.

The word equation for the reaction is:

hydrated cobalt chloride ⇌ anhydrous cobalt chloride + water

This is the method used.

1. Add 2.0 g of hydrated cobalt chloride to an empty test tube.

2. Measure the mass of the test tube and contents.

3. Heat the test tube and contents gently for 30 seconds.

4. Allow the test tube and contents to cool.

5. Measure the mass of the test tube and contents.

6. Repeat steps 3 to 5 until the mass of the test tube and contents does not change.

Table 9 shows the results.

Table 9

| Total heating time in seconds | Mass of test tube and contents in grams |
|---|---|
| 0 | 26.5 |
| 30 | 26.2 |
| 60 | 25.9 |
| 90 | 25.6 |
| 120 | 25.6 |

**09.1** Determine the mass of the empty test tube.

Mass of empty test tube = _____ g

**[1 mark]**

**09.2** Explain why the mass of the test tube and contents decreased.

**[2 marks]**

**09.3** Suggest why the test tube and contents were heated until the mass did not change.

**[1 mark]**

**09.4** Energy is taken in from the surroundings when hydrated cobalt chloride is heated.

When 238 g of hydrated cobalt chloride is heated until the mass does not change,

88.1 kJ of energy is taken in.

The student heated 2.00 g of hydrated cobalt chloride until the mass did not change.

Calculate the energy taken in during this reaction.

Give your answer to 3 significant figures.

Energy taken in (3 significant figures) = _____ kJ

**[3 marks]**

**09.5** What type of reaction takes place when hydrated cobalt chloride is heated?

**[1 mark]**

**Q3 · June 2023 · Paper 2 Foundation · Q4 · [9 marks]**

This question also needs Quantitative chemistry.

This question is about a reversible reaction.

A student heated calcium hydroxide to produce calcium oxide and water vapour.

This is the method used.

1. Add 2.00 g of calcium hydroxide into a test tube.

2. Heat the test tube and contents for 1 minute using a Bunsen burner.

3. Allow the test tube and contents to cool.

4. Weigh the test tube and contents.

5. Repeat steps 2 to 4 five more times.

**04.1** Table 3 gives the appearance of the reactant and of the products.

Table 3

| | Compound | Appearance |
|---|---|---|
| Reactant | calcium hydroxide | white powder |
| Products | calcium oxide | white powder |
| | water vapour | colourless gas |

The student looked at the test tube and contents during heating.

The student could **not** tell that a chemical reaction was taking place by looking at the test tube and contents.

Give **two** reasons why.

Use the information in Table 3.

**[2 marks]**

1

2

**04.2** Accurate results are **not** produced if solid powders escape from the test tube during heating.

Suggest why sealing the test tube with a stopper is **not** a good way of preventing the solid powders from escaping.

**[1 mark]**

**04.3** The student wanted to calculate the mass of the contents of the test tube after each minute of heating.

The student weighed the test tube and contents after each minute of heating.

What **other** measurement is also needed to calculate the mass of the contents of the test tube?

Tick (✓) **one** box.

| | |
|---|---|
| The change in mass of the contents of the test tube at the end | ☐ |
| The mass of the contents of the test tube at the start | ☐ |
| The mass of the empty test tube | ☐ |

**[1 mark]**

**04.4** The student heated 2.00 g of calcium hydroxide to produce calcium oxide and water vapour.

Table 4 shows the results.

Table 4

| Total heating time in minutes | Mass of contents of test tube in grams |
|---|---|
| 0 | 2.00 |
| 1 | 1.76 |
| 2 | 1.64 |
| 3 | 1.56 |
| 4 | 1.52 |
| 5 | 1.51 |
| 6 | 1.51 |

Complete the sentence.

Choose the answer from the box.

Use Table 4.

3 minutes 4 minutes 5 minutes 6 minutes

The minimum heating time needed for all of the calcium hydroxide to be changed into calcium oxide and water vapour is _____ .

**[1 mark]**

**04.5** Calculate the total mass of water vapour produced by heating the calcium hydroxide.

Use Table 4.

Mass = _____ g

**[2 marks]**

**04.6** The word equation for the reaction is:

calcium hydroxide ⇌ calcium oxide + water

The reaction is reversible.

When 4.00 g of calcium hydroxide is completely changed into calcium oxide and water:

- 3.03 g of calcium oxide is produced
- 5.90 kJ of energy is taken in from the surroundings.

3.03 g of calcium oxide reacts completely with water to produce 4.00 g of calcium hydroxide.

How much energy is transferred to the surroundings in this reaction?

Tick (✓) **one** box.

| | |
|---|---|
| Less than 5.90 kJ | ☐ |
| 5.90 kJ | ☐ |
| More than 5.90 kJ | ☐ |

**[1 mark]**

**04.7** The forward reaction takes in energy from the surroundings.

Complete the sentence.

Choose the answer from the box.

combustion endothermic exothermic

The forward reaction is _____ .

**[1 mark]**

**Q4 · June 2023 · Paper 2 Foundation · Q8 · Paper 2 Higher · Q1 · [10 marks]**

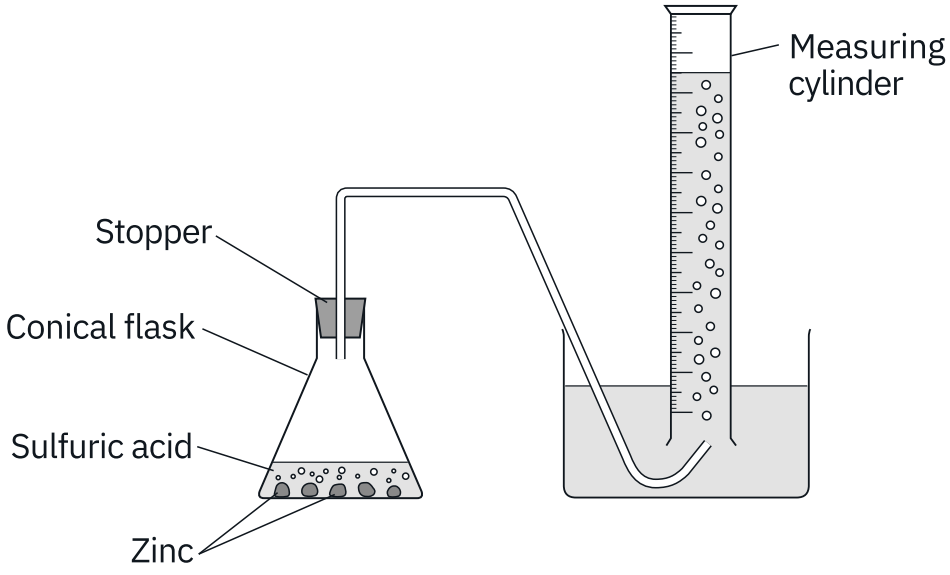
This question also needs Chemical analysis.

A student investigated the rate of the reaction between zinc and sulfuric acid.

Hydrogen gas is produced during this reaction.

Figure 7 shows the apparatus.

Figure 7




This is the method used.

1. Add 50 $cm^3$ of sulfuric acid to a conical flask.

2. Add 2.0 g of zinc to the conical flask.

3. Quickly put a stopper in the conical flask and start a timer.

4. Measure the time taken to collect 20 $cm^3$ of gas.

5. Repeat steps 1 to 4 three more times.

**08.1** Suggest why the stopper must be put in the conical flask as quickly as possible in step 3.

**[1 mark]**

**08.2** The student calculated the rate of the reaction for each trial.

Table 7 shows the results of the calculations.

Table 7

| | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** |
|---|---|---|---|---|
| Rate of reaction in $cm^3/s$ | 0.78 | 0.81 | 0.68 | 0.81 |

Determine the mean time taken to collect 20 $cm^3$ of gas.

Do **not** include any anomalous results.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas collected}}{\text{mean time taken}}$$

Mean time taken = _____ s

**[5 marks]**

**08.3** The student changed the investigation so that the mean time taken to collect 20 $cm^3$ of gas was greater.

Which **two** changes would increase the mean time taken to collect 20 $cm^3$ of gas?

Tick (✓) **two** boxes.

| | |
|---|---|
| Use a catalyst | ☐ |
| Use a larger conical flask | ☐ |
| Use a lower temperature | ☐ |
| Use smaller pieces of zinc | ☐ |
| Use sulfuric acid of a lower concentration | ☐ |

**[2 marks]**

**08.4** Hydrogen gas is produced during this reaction.

Describe the test for hydrogen gas.

Give the result of the test.

**[2 marks]**

Test

Result

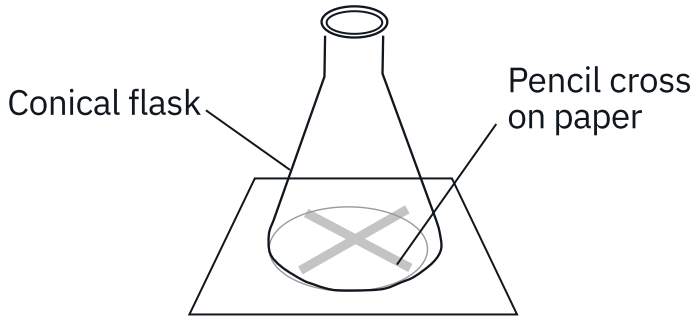
**Q5 · June 2024 · Paper 2 Foundation · Q5 · [11 marks]**

A student investigated the rate of the reaction of sodium thiosulfate solution with hydrochloric acid.

When sodium thiosulfate solution reacts with hydrochloric acid, the mixture becomes cloudy.

Figure 6 shows the apparatus.

Figure 6




This is the method used.

1. Put 75 $cm^3$ of sodium thiosulfate solution in a conical flask.

2. Draw a pencil cross on paper.

3. Put the conical flask on the pencil cross.

4. Add 15 $cm^3$ of hydrochloric acid to the contents of the conical flask.

5. Swirl the conical flask to mix the contents and immediately start a timer.

6. Stop the timer when the pencil cross is no longer visible through the reaction mixture.

7. Repeat steps 1 to 6 using different concentrations of sodium thiosulfate solution.

**05.1** Explain why a 50 $cm^3$ conical flask is unsuitable to use in this method.

**[2 marks]**

**05.2** Name a piece of equipment suitable for measuring the volume of sodium thiosulfate solution.

**[1 mark]**

**05.3** The student measured the time taken for the pencil cross to be no longer visible for different concentrations of sodium thiosulfate solution.

Draw **one** line from each type of variable to the variable in this investigation.

| Type of variable | Variable in this investigation |
|---|---|
| | Concentration of sodium thiosulfate solution |
| | Size of conical flask |
| Dependent variable | |
| | Temperature of sodium thiosulfate solution |
| Independent variable | |
| | Time for pencil cross to become no longer visible |
| | Volume of hydrochloric acid |

**[2 marks]**

*Draw your answer on the figure above.*

**05.4** What effect will using a darker pencil cross have on the time taken for the cross to be no longer visible?

Tick (✓) **one** box.

| | |
|---|---|
| The time taken will decrease. | ☐ |
| The time taken will be the same. | ☐ |
| The time taken will increase. | ☐ |

**[1 mark]**

**05.5** Table 2 shows the results.

Table 2

| **Concentration of sodium thiosulfate solution in g/dm$^3$** | **Time for cross to become no longer visible in seconds** |
|---|---|
| 8 | 120 |
| 16 | 60 |
| 24 | 40 |
| 32 | 30 |

Which concentration of sodium thiosulfate solution had the highest rate of reaction?

Tick (✓) **one** box.

| | |
|---|---|
| 8 g/dm$^3$ | ☐ |
| 16 g/dm$^3$ | ☐ |
| 24 g/dm$^3$ | ☐ |
| 32 g/dm$^3$ | ☐ |

**[1 mark]**

**05.6** Increasing the concentration of sodium thiosulfate solution changes the rate of the reaction with hydrochloric acid.

Which **two** statements explain the effect of increasing the concentration?

Tick (✓) **two** boxes.

| | |
|---|---|
| The particles are closer together. | ☐ |
| The particles are further apart. | ☐ |
| The particles collide less frequently. | ☐ |
| The particles collide more frequently. | ☐ |
| The particles move faster. | ☐ |
| The particles move slower. | ☐ |

**[2 marks]**

**05.7** The effect on the time taken for the cross to disappear can also be investigated by:

- changing the temperature of the hydrochloric acid
- changing the concentration of the hydrochloric acid.

Complete the sentences.

Choose the answers from the box.

decreases stays the same increases

If the temperature of the hydrochloric acid is **increased**, the time taken for the cross to disappear _____ .

If the concentration of the hydrochloric acid is **decreased**, the time taken for the cross to disappear _____ .

**[2 marks]**

**Q6 · June 2025 · Paper 2 Foundation · Q3 · [8 marks]**

This question also needs Using resources.

Cement, concrete and steel are building materials.

Cement contains calcium oxide.

Calcium oxide reacts with water to produce calcium hydroxide.

The equation for the reaction is:

calcium oxide + water ⇌ calcium hydroxide

**03.1** How does the equation show that this reaction is reversible?

**[1 mark]**

**03.2** The forward reaction is exothermic.

What type of reaction is the reverse reaction?

**[1 mark]**

**03.3** When excess water is added to 20 g of calcium oxide, 23 kJ of energy is released.

Calculate the energy released when excess water is added to 4 g of calcium oxide.

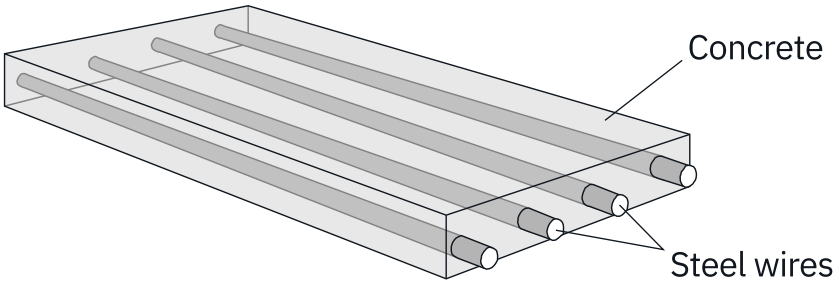
Energy released = _____ kJ

**[2 marks]**

**03.4** Pre-stressed concrete contains steel wires within the concrete.

Figure 2 shows the structure of a piece of pre-stressed concrete.

Figure 2




Pre-stressed concrete is a composite.

Draw **one** line from each component of a composite to a material in pre-stressed concrete.

| **Component of composite** | **Material in pre-stressed concrete** |
|---|---|
| Binder | Concrete |
| Reinforcement | Pre-stressed concrete |
| | Steel wires |

**[2 marks]**

*Draw your answer on the figure above.*

**03.5** Which metal do **all** steels contain?

**[1 mark]**

**03.6** Bricks are also building materials.

Bricks are ceramics.

Which material is used to make bricks?

Tick (✓) **one** box.

| | |
|---|---|
| Aluminium | ☐ |
| Clay | ☐ |
| Poly(ethene) | ☐ |

**[1 mark]**

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