AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.4

Chemical measurements

Past-paper questions

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2022**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

5.3.1.4 Chemical measurements

Question 01

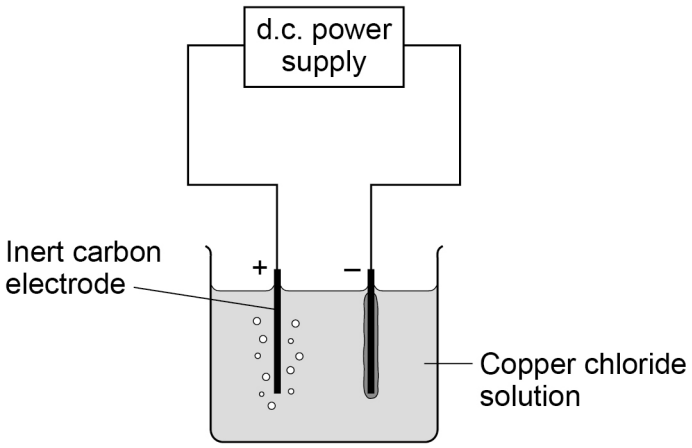
June 2018 | 8464/C/1H | Original Q1

0 1 This question is about electrolysis.

A student investigates the mass of copper produced during electrolysis of copper chloride solution.

Figure 1 shows the apparatus.

Figure 1



0 1 . 1 Which gas is produced at the positive electrode (anode)?

[1 mark]

Tick **one** box.

carbon dioxide ☐

chlorine ☐

hydrogen ☐

oxygen ☐

5.3.1.4 Chemical measurements

Question 01 · continued

0 1 . 2 Copper is produced at the negative electrode (cathode).

What does this tell you about the reactivity of copper?

[1 mark]

Tick **one** box.

Copper is less reactive than hydrogen ☐

Copper is less reactive than oxygen ☐

Copper is more reactive than carbon ☐

Copper is more reactive than chlorine ☐

Table 1 shows the student's results.

Table 1

	Total mass of copper produced in mg			
Time in mins	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Mean**
1	0.60	0.58	0.62	0.60
2	1.17	1.22	1.21	1.20
4	2.40	2.41	2.39	2.40
5	3.02	**X**	3.01	3.06

0 1 . 3 Determine the **mean** mass of copper produced after 3 minutes.

[1 mark]

Mass = _____ mg

Question 1 continues on the next page

5.3.1.4 Chemical measurements

Question 01 · continued

0 1 . 4 Calculate the mass **X** of copper produced in **Experiment 2** after 5 minutes.

Use **Table 1** on page 3

[2 marks]

Mass **X** = _____ mg

0 1 . 5 The copper chloride solution used in the investigation contained 300 grams per dm^3 of solid $CuCl_2$ dissolved in 1 dm^3 of water.

The student used 50 cm^3 of copper chloride solution in each experiment.

Calculate the mass of solid copper chloride used in each experiment.

[3 marks]

Mass = _____ g

8

5.3.1.4 Chemical measurements

Question 02

0 2 Some students investigated the effect of temperature on the rate of reaction.

0 2 . 1 The students reacted sodium thiosulfate solution with hydrochloric acid.

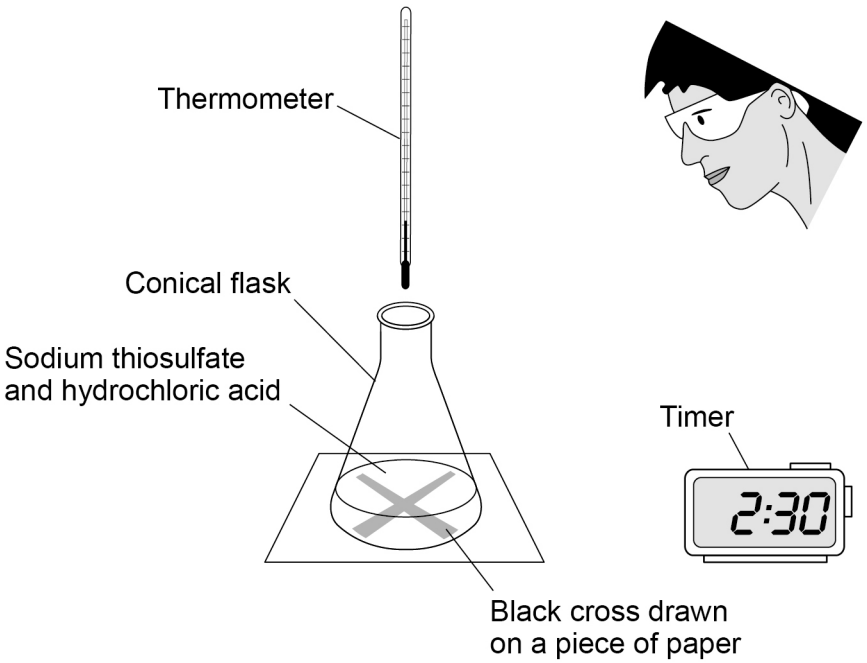
This is the method used.

1. Use a beaker to measure 50 cm^3 of heated sodium thiosulfate solution into a conical flask.
2. Measure the temperature of the room.
3. Put the conical flask on a black cross drawn on a piece of paper.
4. Start a timer.
5. Use the same beaker to measure 10 cm^3 of hydrochloric acid into the conical flask.
6. Stop the timer when the cross is no longer visible.

The students repeated the experiment at a different room temperature.

Figure 1 shows the apparatus.

Figure 1



5.3.1.4 Chemical measurements

Question 02 · continued

The method contains errors and does **not** produce accurate results.

Describe a method the students should use to produce accurate results.

You do **not** need to write about safety precautions.

[6 marks]

Question 2 continues on the next page

5.3.1.4 Chemical measurements

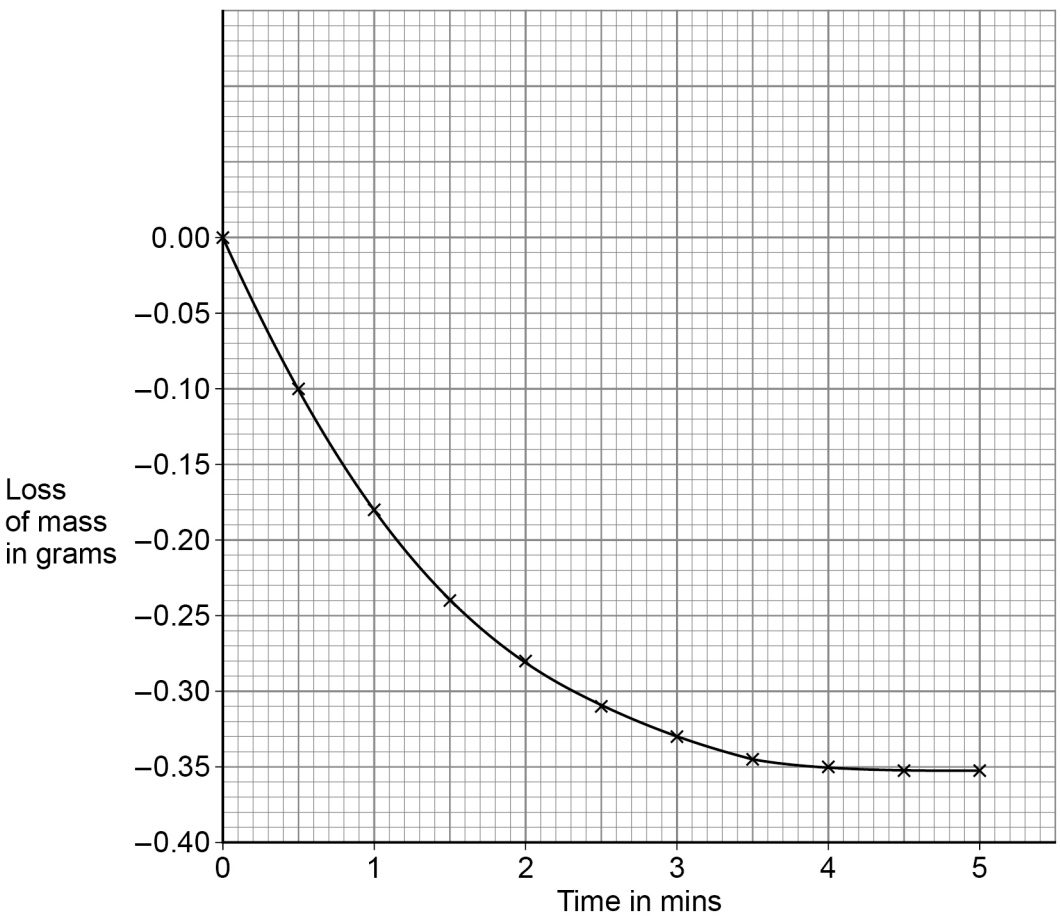
Question 02 · continued

Some students investigated the effect of temperature on the rate of a different reaction.

They recorded the loss of mass from their apparatus at 40 °C

Figure 2 shows the results.

Figure 2



5.3.1.4 Chemical measurements

Question 02 · continued

0 2 . 2 Calculate the mean rate of reaction between 1 minute and 3 minutes at 40 °C

Use **Figure 2** and the equation:

$$\text{Mean rate of reaction} = \frac{\text{change in mass of gas in g}}{\text{time in mins}}$$

[3 marks]

Mean rate of reaction = _____ g/min

0 2 . 3 Draw a curve on **Figure 2** for the results you would expect at a temperature of 50 °C instead of 40 °C

[2 marks]

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5.3.1.4 Chemical measurements

Question 03

0 5 Atmospheric pollution is emitted by cars.

Some car emissions contain nitrogen dioxide.

0 5 . 1 Describe how nitrogen dioxide (NO_2) is produced in the engine of a car that burns fossil fuels.

[3 marks]

Table 3 shows the concentration of nitrogen dioxide in the air in three different areas for 1 week.

Table 3

	Concentration of nitrogen dioxide in the air in micrograms per m^3		
Day	**City centre**	**Countryside**	**Motorway**
Monday	35	8	22
Tuesday	37	8	23
Wednesday	37	8	23
Thursday	34	8	23
Friday	37	8	23
Saturday	29	7	20
Sunday	**X**	6	17

5.3.1.4 Chemical measurements

Question 03 · continued

0 5 . 2 The mean value for nitrogen dioxide in the air for the whole week in the city centre is 33 micrograms per m^3.

Calculate the value (**X**) for the concentration of nitrogen dioxide in the air in the city centre on Sunday.

[2 marks]

X = _____ micrograms per m^3

0 5 . 3 Each value in **Table 3** has an uncertainty of ± 2 micrograms per m^3.

Explain why this uncertainty is **most** significant for countryside data.

[2 marks]

Question 5 continues on the next page

5.3.1.4 Chemical measurements

Question 03 · continued

Nitrogen dioxide is removed from car emissions by catalytic converters.

0 5 . 4 In a catalytic converter nitrogen dioxide (NO_2) reacts to produce nitrogen and oxygen.

Complete the equation for the reaction.

You should balance the equation.

[2 marks]

_____ $NO_2 \rightarrow$ _____ + _____

0 5 . 5 The catalyst in a catalytic converter contains platinum.

Platinum is a finite resource.

What is meant by a 'finite resource'?

[1 mark]

0 5 . 6 Emissions from cars contain carbon dioxide.

Explain why carbon dioxide emissions during use and operation are **not** the total carbon footprint for a car.

Refer to the stages of the life cycle assessment of a car in your answer.

[3 marks]

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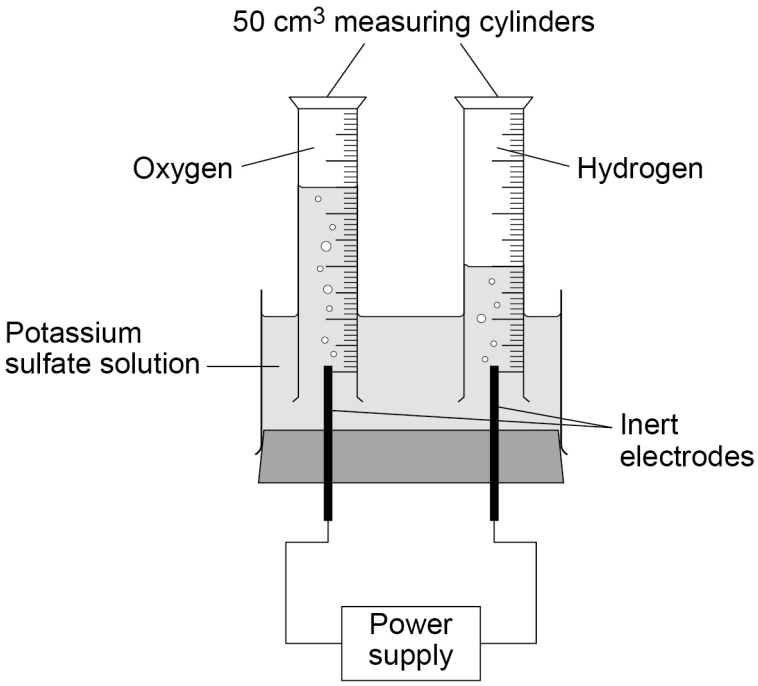
5.3.1.4 Chemical measurements

Question 04

0 2 This question is about electrolysis.

Figure 2 shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

Figure 2



0 2 . 1 Potassium sulfate contains K^+ and SO_4^{2-} ions.

What is the formula of potassium sulfate?

[1 mark]

Tick (✓) **one** box.

KSO_4 ☐

K_2SO_4 ☐

$K(SO_4)_2$ ☐

$K_2(SO_4)_2$ ☐

5.3.1.4 Chemical measurements

Question 04 · continued

0 2 . 2 What are the volumes of gases collected in the electrolysis experiment?

Use **Figure 2**.

[1 mark]

Volume of hydrogen = _____ cm^3

Volume of oxygen = _____ cm^3

0 2 . 3 A student made the following hypothesis:

'The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.'

Explain how the volumes of gases collected in the experiment in **Figure 2** support the student's hypothesis.

Use your answer to Question **02.2**

[2 marks]

Question 2 continues on the next page

0 2 . 4 The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm^3 9 cm^3 10 cm^3 11 cm^3

The mean volume of oxygen collected in the 4 experiments is 9 cm^3

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments?

[1 mark]

Tick (✓) **one** box.

9 ± 1 cm^3 ☐

9 ± 2 cm^3 ☐

9 ± 3 cm^3 ☐

0 2 . 5 The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm^3 of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm^3 of solution.

[3 marks]

Mass = _____ g

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