AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.2.5

Polymers

Past-paper questions

Tier	**Higher**
Question groups	**5**
Available paper years	**2020–2025**

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.

5.2.2.5 Polymers

Question 01

November 2020 | 8464/C/1H | Original Q5

0 5 A student investigated the temperature change when magnesium was added to copper sulfate solution.

This is the method used.

1. Pour 30 cm^3 of copper sulfate solution into a polystyrene cup.
2. Measure the temperature of copper sulfate solution every minute for 3 minutes.
3. Add magnesium on the fourth minute.
4. Measure the temperature of the mixture at 5 minutes and then every minute up to 14 minutes.

0 5 . 1 What is the dependent variable in this investigation?

[1 mark]

Question 5 continues on the next page

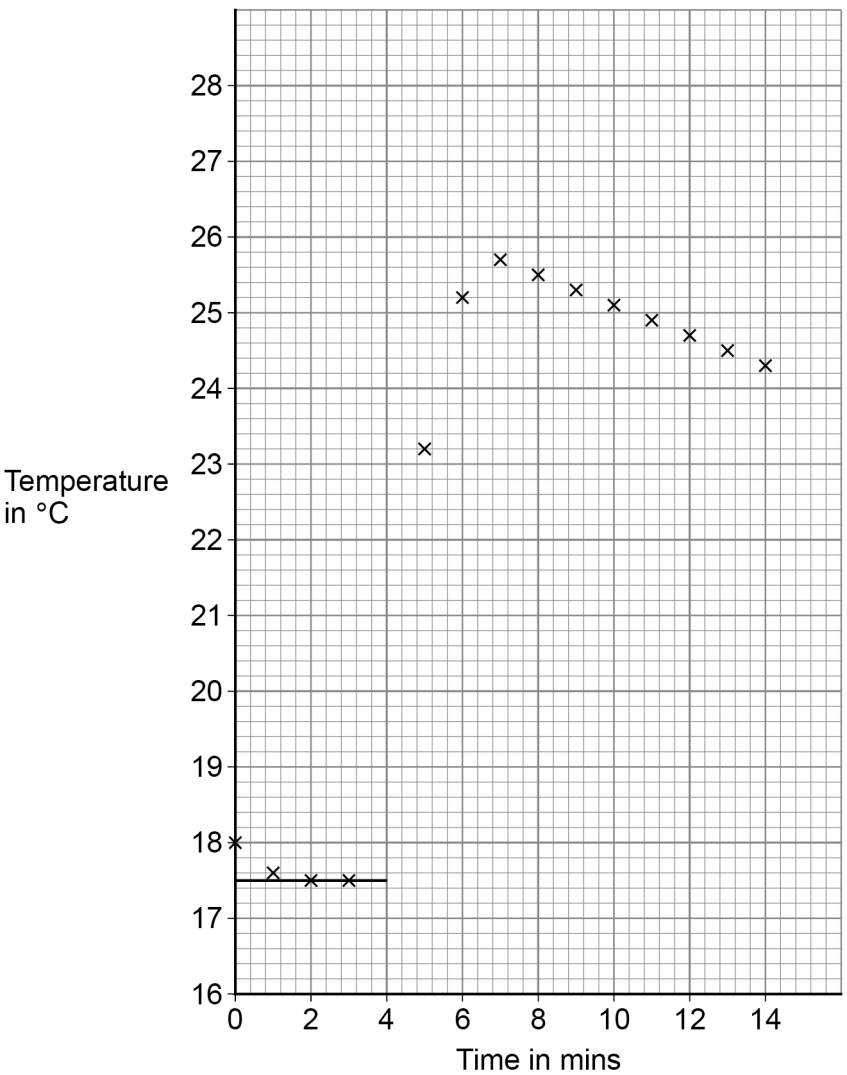
5.2.2.5 Polymers

Question 01 · continued

The student used the results to plot a graph.

Figure 4 shows the graph.

Figure 4



5.2.2.5 Polymers

Question 01 · continued

0 5 . 2 Suggest why the copper sulfate solution was left for four minutes before adding the magnesium.

[1 mark]

0 5 . 3 Complete **Figure 4** by:

- drawing a line of best fit through all the points after 7 minutes
- extending the line back to 4 minutes.

[2 marks]

0 5 . 4 The temperature change for the reaction is the temperature difference between the two graph lines at 4 minutes.

Determine the temperature change for the reaction.

Use **Figure 4**.

[2 marks]

Temperature change = _____ °C

0 5 . 5 Explain why the temperature of the mixture decreases after 7 minutes.

[2 marks]

Question 01 · continued

0 5 . 6 The student repeated the experiment with an unknown metal **Q** instead of magnesium.

All the other variables were kept the same.

The student recorded a smaller temperature change.

Suggest the identity of metal **Q**.

Give **one** reason for your answer.

[2 marks]

Metal **Q** _____

Reason _____

_____

0 5 . 7 A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm^3 of water.

Calculate the mass of copper sulfate in 30.0 cm^3 of this solution.

Relative formula mass (M_r): $CuSO_4$ = 159.5

[4 marks]

_____

_____

_____

_____

_____

_____

Mass = _____ g

14

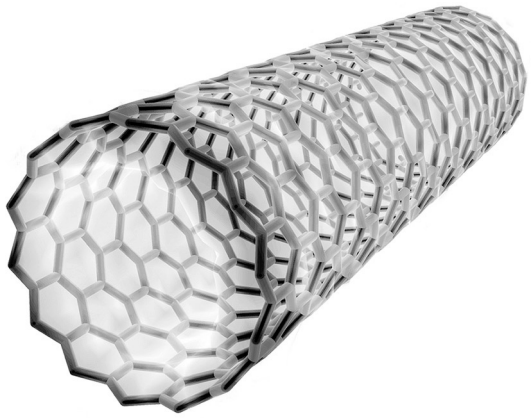
5.2.2.5 Polymers

Question 02

0 5 This question is about structure and bonding.

0 5 . 1 **Figure 5** represents part of a carbon molecule.

Figure 5



Name the type of carbon molecule in **Figure 5**.

[1 mark]

0 5 . 2 Suggest **one** property that makes the carbon molecule in **Figure 5** useful in nanotechnology.

[1 mark]

5.2.2.5 Polymers

Question 02 · continued

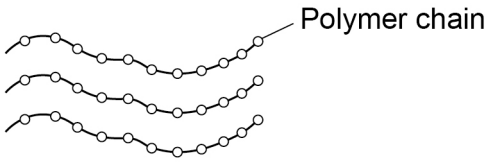
0 5 . 3 An alloy of aluminium contains small amounts of other metals.

Explain why other metals are added to aluminium.

[4 marks]

0 5 . 4 **Figure 6** represents part of the structure of a polymer.

Figure 6



Compare the bonding within the chains with the forces between the chains in this polymer.

[3 marks]

9

5.2.2.5 Polymers

Question 03

0 4 Nitric acid (HNO_3) is a strong acid.

0 4 . 1 What is meant by a 'strong acid'?

[1 mark]

0 4 . 2 Nitric acid is used as a dilute aqueous solution.

What is meant by 'dilute aqueous solution'?

[1 mark]

Question 4 continues on the next page

0 4 . 3 10 cm^3 of a nitric acid solution has a pH of 1

Water is added to the nitric acid solution to change the pH of the nitric acid solution to pH 3

How does the hydrogen ion concentration change?

[1 mark]

Tick (✓) **one** box.

- Decreases by a factor of 100 ☐
- Decreases by a factor of 10 ☐
- Increases by a factor of 10 ☐
- Increases by a factor of 100 ☐

0 4 . 4 Write the **ionic** equation for the reaction between an acid and an alkali.

[1 mark]

_____ + _____ → _____

Question 03 · continued

The equation shows the reaction between magnesium carbonate and nitric acid.

$$MgCO_3 + 2\,HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$$

0 4 . 5 What is the ratio of the number of moles of magnesium carbonate to the number of moles of nitric acid in the reaction?

[1 mark]

Tick (✓) **one** box.

1 : 1 ☐

1 : 2 ☐

2 : 1 ☐

2 : 2 ☐

0 4 . 6 A student mixed some magnesium carbonate with excess nitric acid.

The student then added two drops of universal indicator to the solution.

What colour was the solution after the addition of universal indicator?

[1 mark]

Tick (✓) **one** box.

Red ☐

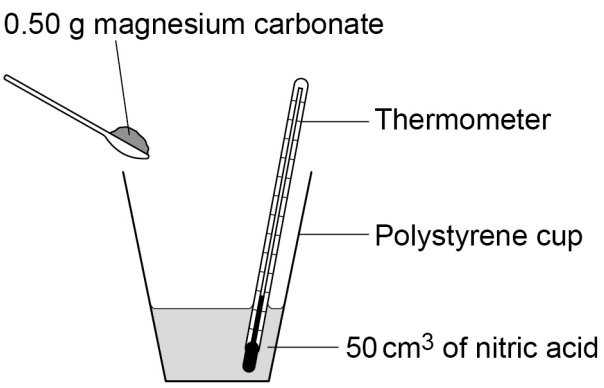
Green ☐

Blue ☐

A student investigated the temperature change when different masses of magnesium carbonate were reacted with excess nitric acid.

Figure 6 shows the apparatus.

Figure 6



This is the method used.

1. Pour 50 cm^3 of nitric acid into a polystyrene cup.
2. Measure the temperature of the solution.
3. Add 0.50 g of magnesium carbonate.
4. Stir the mixture.
5. Measure the temperature.
6. Repeat steps 1 to 5 with different masses of magnesium carbonate.

0 4 . 7 Give **two** improvements to the **method** to produce more accurate results.

Do **not** refer to improvements to the apparatus in your answer.

[2 marks]

1 _____

_____

2 _____

_____

8

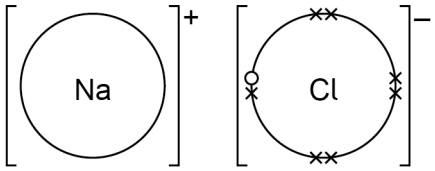
5.2.2.5 Polymers

Question 04

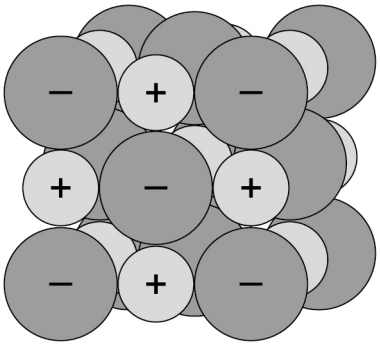
0 7 This question is about bonding and structures.

0 7 . 1 **Figure 10** represents two models of sodium chloride.

Figure 10



Model **A**



Model **B**

Give **two** limitations of model **A** compared with model **B**.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 2 Aluminium sulfate consists of the ions:

- Al^{3+}
- SO_4^{2-}

What is the formula of aluminium sulfate?

[1 mark]

_____

5.2.2.5 Polymers

Question 04 · continued

0 7 . 3 Metals have metallic bonding.

Suggest **one** reason why aluminium metal conducts electricity better than sodium metal.

[1 mark]

0 7 . 4 Silicon dioxide and the polymer poly(ethene) are solid substances.

Compare silicon dioxide with the polymer, poly(ethene).

Answer in terms of structure and bonding.

[4 marks]

Extra space

8

5.2.2.5 Polymers

Question 05

June 2025 | 8464/C/2H | Original Q3

0 3 Crude oil is a finite resource found in rocks.

0 3 . 1 What is meant by a 'finite' resource?

[1 mark]

0 3 . 2 Most of the compounds in crude oil are hydrocarbons.

Define the term 'hydrocarbon'.

[1 mark]

5.2.2.5 Polymers

0 3 . 3 Crude oil found in different areas has different compositions.

Table 2 shows the percentage (%) composition of crude oil from one area.

Table 2

Fraction	Percentage (%) of fraction
Petrol	31.3
Kerosene	13.4
Diesel oil	14.4
Heavy fuel oil	40.9

The volume of crude oil is measured in a unit called 'barrels'.

1 barrel = 159 dm^3

Calculate the volume of **petrol** in dm^3 in 90 barrels of crude oil.

Give your answer to 3 significant figures.

[4 marks]

Volume of petrol (3 significant figures) = _____ dm^3

5.2.2.5 Polymers

Question 05 · continued

0 3 . 4 Fractions from crude oil can be processed to produce many useful materials by the petrochemical industry.

Which is a useful material produced by the petrochemical industry?

[1 mark]

Tick (✓) **one** box.

- Alloys ☐
- Ceramics ☐
- Fertilisers ☐
- Lubricants ☐

0 3 . 5 Catalytic cracking is used to crack hydrocarbons.

Name **one** other method of cracking hydrocarbons.

[1 mark]

_____

0 3 . 6 Alkanes are produced by cracking.

Hydrocarbon **Z** is a different type of hydrocarbon to alkanes.

Hydrocarbon **Z**:

- is also produced by cracking
- can be used to produce polymers.

Describe a test for hydrocarbon **Z**.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

10