AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.10.1.4

Alternative methods of extracting metals (HT only)

Past-paper questions

Tier	**Higher**
Question groups	**5**
Available paper years	**2019–2025**

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.

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 01

June 2019 | 8464/C/2H | Original Q4

0 4 This question is about copper and fuels.

0 4 . 1 Copper is extracted from low-grade ores by phytomining.

Describe how copper metal is produced by phytomining.

[4 marks]

0 4 . 2 Another method of extracting copper from low-grade ores is bioleaching.

A solution of copper sulfate ($CuSO_4$) produced by bioleaching has a concentration of 0.319 g/dm^3

Relative atomic masses (A_r): Cu = 63.5 O = 16 S = 32

Calculate the number of moles of copper that can be produced from 1 dm^3 of this solution.

[3 marks]

Number of moles of copper = _____ mol

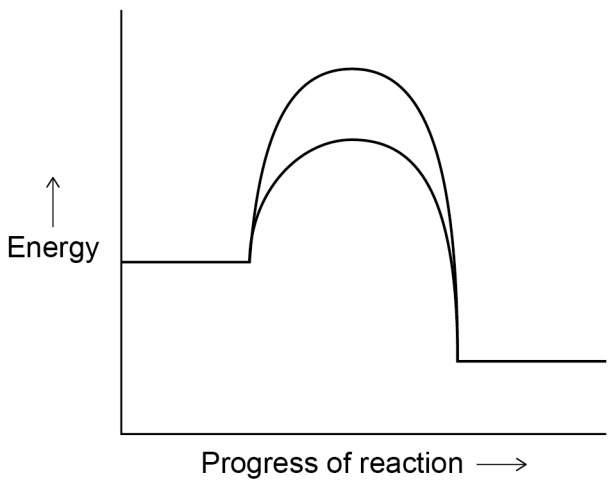
5.10.1.4 Alternative methods of extracting metals (HT only)

Question 01 · continued

Copper is used as a catalyst.

Figure 1 shows reaction profiles for a reaction with and without a catalyst.

Figure 1



0 4 . 3 How do the reaction profiles show that using a catalyst does **not** affect the overall energy change for the reaction?

[1 mark]

Tick (✓) **one** box.

- Both reaction profiles show exothermic reactions. ☐
- Both reaction profiles start at the same energy level and end at the same energy level. ☐
- Both reaction profiles show the activation energy. ☐
- The activation energy for the uncatalysed reaction is much lower than for the catalysed reaction. ☐

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 01 · continued

0 4 . 4 Copper is a catalyst in a reaction to produce ethanol from carbon dioxide.

Ethanol (C_2H_5OH) is used as a fuel.

Suggest why producing ethanol from carbon dioxide is sustainable.

[2 marks]

0 4 . 5 Chemistry plays an important role in sustainable development.

What is sustainable development?

[2 marks]

12

5.10.1.4 Alternative methods of extracting metals (HT only)

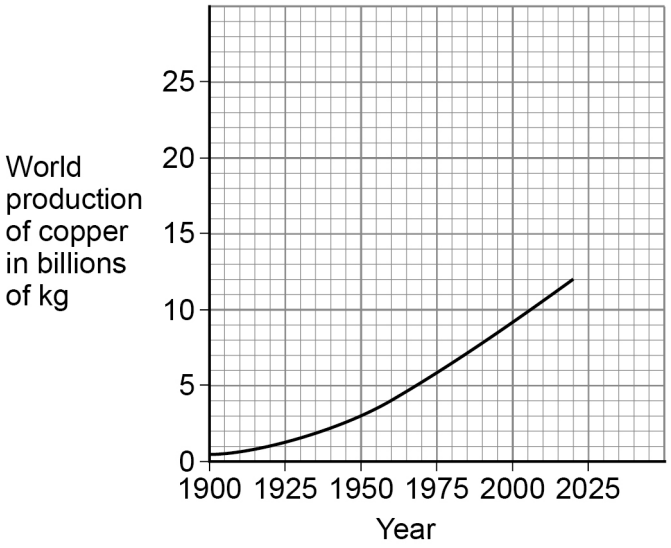
Question 02

November 2021 | 8464/C/2H | Original Q4

0 4 Industries use the Earth's natural copper resources to produce useful products.

Figure 4 shows the world production of copper from 1900 to 2020.

Figure 4



0 4 . 1 Describe the trend shown by the graph in **Figure 4**.

[2 marks]

0 4 . 2 Suggest **one** reason for the trend in **Figure 4**.

[1 mark]

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 02 · continued

0 4 . 3 Suggest **one** reason why the trend cannot be used to accurately predict the future world production of copper.

[1 mark]

Question 4 continues on the next page

Question 02 · continued

0 4 . 4 High-grade copper resources are now difficult to find.

Phytomining is used to extract copper from low-grade ores.

There are five stages, **A**, **B**, **C**, **D** and **E**, in phytomining.

The stages are **not** in the correct order.

Stage **A** Copper compounds from ash are dissolved in acid.

Stage **B** Plants absorb metal compounds.

Stage **C** Plants are burned.

Stage **D** Plants are harvested.

Stage **E** Solution of copper compound is electrolysed.

What is the correct order of stages **A**, **B**, **C**, **D**, and **E**?

[1 mark]

Tick (✓) **one** box.

B, **C**, **D**, **E**, **A** ☐

B, **D**, **C**, **A**, **E** ☐

D, **B**, **C**, **E**, **A** ☐

D, **C**, **B**, **A**, **E** ☐

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 02 · continued

0 4 . 5 Give **two** disadvantages of phytomining compared with traditional mining methods.

Do **not** refer to cost in your answer.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 6 In one year, 8.89×10^9 kg of copper was produced.

41.0% of this copper was produced from recycled copper.

The energy needed to produce 1 kg of copper from copper ore is 70.4 MJ.

The energy needed to produce 1 kg of recycled copper is 27.2 MJ.

Calculate the difference in energy used if all the copper was produced from recycling.

Give your answer to 3 significant figures.

[5 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Difference in energy used (3 significant figures) = _____ MJ

12

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 03

June 2022 | 8464/C/2H | Original Q5

0 5 This question is about the Earth's atmosphere and the Earth's resources.

0 5 . 1 After the formation of the Earth's early atmosphere, the amounts of nitrogen and oxygen in the atmosphere changed.

Explain the main changes in the amounts of nitrogen and oxygen in the Earth's atmosphere.

[4 marks]

Nitrogen _____

_____

_____

Oxygen _____

_____

_____

0 5 . 2 Describe how coal was formed from the carbon dioxide present in the Earth's early atmosphere.

[4 marks]

_____

_____

_____

_____

_____

_____

0 5 . 3 The combustion of 1.0 kg of coal produces more carbon dioxide than the combustion of 1.0 kg of natural gas.

Suggest why.

[1 mark]

_____

_____

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 03 · continued

Metals are extracted from metal ores found in the Earth.

0 5 . 4 Describe how bioleaching is used to extract copper from low grade ores.

[3 marks]

0 5 . 5 Phytomining uses plants to extract nickel from low grade ores.

The plants contain 0.792% nickel by mass.

The plants are burned to produce ash.

The ash from these plants contains 4.80% nickel by mass.

Calculate the mass of ash produced from burning 1000 kg of plants.

Give your answer in grams in standard form.

[4 marks]

Mass of ash (in standard form) = _____ g

16

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 04

June 2024 | 8464/C/2H | Original Q6

0 6 The Earth's natural resources are used to manufacture useful products.

One useful product is potable water.

Potable water can be produced from sea water by distillation.

0 6 . 1 Give **one disadvantage** of using distillation to produce potable water.

[1 mark]

0 6 . 2 Describe **one** other method to produce potable water from sea water.

[2 marks]

Question 6 continues on the next page

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 04 · continued

A student investigated the mass of dissolved solids in a 100 cm^3 sample of sea water.

This is the method used.

1. Weigh an evaporating basin.
2. Measure 100 cm^3 of sea water.
3. Pour the sea water into the evaporating basin.
4. Heat the evaporating basin.
5. Weigh the evaporating basin and contents.
6. Calculate the mass of dissolved solids in the sea water.

0 6 . 3 Explain how repeating steps 4 and 5 would improve this method.

[2 marks]

0 6 . 4 The total mass of dissolved solids in a 100 cm^3 sample of sea water is 3.50 g.

The percentage of sodium chloride in the dissolved solids is 77.8%.

Calculate the mass of sodium chloride dissolved in the 100 cm^3 sample of sea water.

[2 marks]

Mass of sodium chloride = _____ g

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 04 · continued

Biological methods are used to extract metal compounds from metal ores.

0 6 . 5 One method of producing copper from low-grade copper ores is by using bacteria.

The bacteria produce leachate solutions that contain copper compounds.

Give **two** methods that can be used to extract copper from these leachate solutions.

[2 marks]

1 _____

_____

2 _____

_____

Question 6 continues on the next page

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 04 · continued

Phytomining uses plants to absorb metal compounds from low-grade ores.

0 6 . 6 Describe how the metal compounds are obtained from the plants.

[3 marks]

0 6 . 7 Nickel is produced by phytomining.

One hectare of plants produces 215 kg of nickel.

Determine the area required to produce 750 kg of nickel.

Give your answer in m^2.

One hectare = 10 000 m^2

[3 marks]

Area required = _____ m^2

15

5.10.1.4 Alternative methods of extracting metals (HT only)

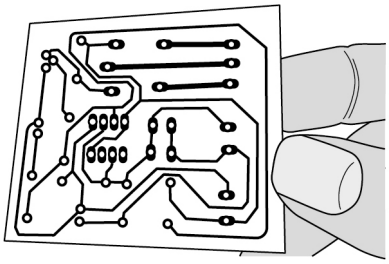
Question 05

June 2025 | 8464/C/2H | Original Q6

0 6 Gold is used in the printed circuit boards found in smartphones.

Figure 6 shows a printed circuit board.

Figure 6



A type of smartphone contains 1.73×10^{-4} moles of gold.

0 6 . 1 In one year, a manufacturer sold 2.48 million of this type of smartphone.

Calculate the total mass of gold contained in 2.48 million of these smartphones.

Give your answer in kilograms.

Relative atomic mass (A_r): Au = 197

[5 marks]

Total mass of gold = _____ kg

0 6 . 2 What is the total number of gold atoms in one of this type of smartphone?

The Avogadro constant = 6.02×10^{23} per mole

[1 mark]

Tick (✓) **one** box.

2.87×10^{-28} ☐

1.04×10^{20} ☐

3.48×10^{27} ☐

0 6 . 3 The materials in printed circuit boards can be recycled.

Bioleaching is one method used to extract gold from printed circuit boards.

Describe how bioleaching is used to extract gold.

[3 marks]

Question 6 continues on the next page

5.10.1.4 Alternative methods of extracting metals (HT only)

Question 05 · continued

0 6 . 4 Copper is also extracted using bioleaching.

Copper can also be extracted from low-grade ores using phytomining.

Phytomining has **not** been widely used to extract copper.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

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