AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.4.1.4

Oxidation and reduction in terms of electrons (HT only)

Past-paper questions

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2025**

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.

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 01

0 8 This question is about iron.

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

0 8 . 1 Name the other product.

[1 mark]

0 8 . 2 Suggest how any unreacted iron can be separated from the mixture.

[1 mark]

Magnesium reacts with iron chloride solution.

$$3\ Mg + 2\ FeCl_3 \rightarrow 2\ Fe + 3\ MgCl_2$$

0 8 . 3 0.120 g of magnesium reacts with excess iron chloride solution.

Relative atomic masses (A_r): Mg = 24 Fe = 56

Calculate the mass of iron produced, in mg

[5 marks]

Mass of iron = _____ mg

Question 8 continues on the next page

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 01 · continued

0 8 . 4 Explain which species is reduced in the reaction between magnesium and iron chloride.

$$3\ Mg + 2\ FeCl_3 \rightarrow 2\ Fe + 3\ MgCl_2$$

Your answer should include the half equation for the reduction.

[3 marks]

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5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 02

November 2020 | 8464/C/1H | Original Q1

0 1 This question is about the extraction of aluminium.

0 1 . 1 An aluminium atom is represented as:

$$^{27}_{13}Al$$

Give the number of electrons and neutrons in the aluminium atom.

[2 marks]

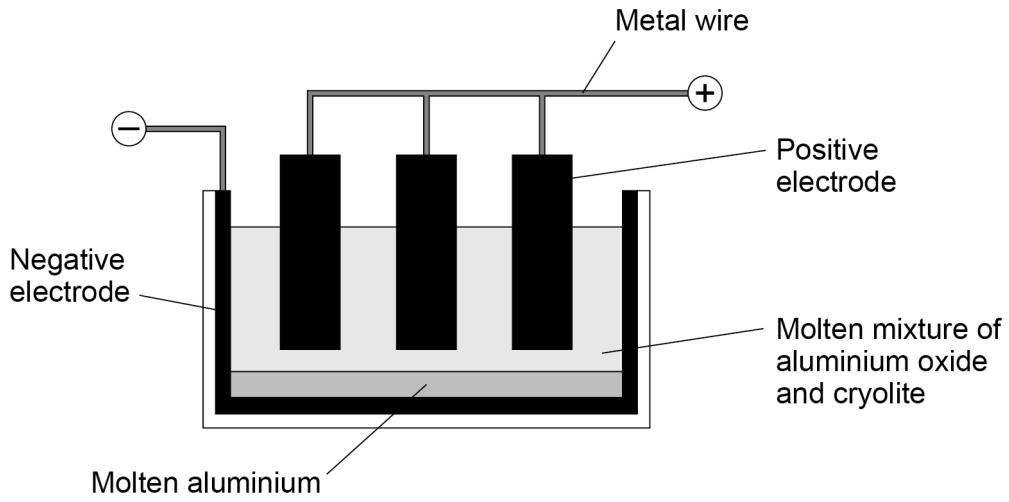
Number of electrons _____

Number of neutrons _____

Aluminium is extracted by the electrolysis of a molten mixture of aluminium oxide and cryolite.

Figure 1 shows the cell used for the electrolysis.

Figure 1



0 1 . 2 Aluminium is produced by the reduction of aluminium oxide (Al_2O_3).

What is meant by the term reduction?

[1 mark]

_____

_____

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 02 · continued

0 1 . 3 Oxygen is formed at the positive carbon electrodes.

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

0 1 . 4 A substance conducts electricity because of free moving, charged particles.

What are the free moving, charged particles in a:

- carbon electrode (made from graphite)
- molten mixture of aluminium oxide and cryolite
- metal wire?

[3 marks]

Carbon electrode (made from graphite) _____

Molten mixture of aluminium oxide and cryolite _____

Metal wire _____

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5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

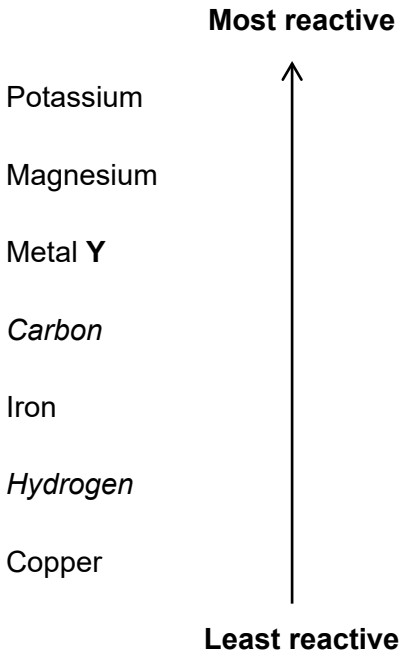
Question 03

June 2022 | 8464/C/1H | Original Q7

0 7 This question is about elements and compounds.

0 7 . 1 **Figure 8** shows a reactivity series.

Figure 8



Give the method and conditions used to extract metal **Y** from a compound of metal **Y**.

[2 marks]

Question 7 continues on the next page

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 03 · continued June 2022 | 8464/C/1H | Original Q7

Sodium reacts with titanium chloride ($TiCl_4$) to produce titanium.

0 7 . 2 Complete the equation.

You should balance the equation.

[2 marks]

$$____ Na + TiCl_4 \rightarrow _____ + _____$$

0 7 . 3 The reaction between sodium and titanium chloride is a redox reaction.

Write a half-equation to show that sodium is oxidised in this reaction.

[2 marks]

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 03 · continued

0 7 . 4 108 g of aluminum reacts with 1.21 kg of copper chloride to produce copper.

The equation for the reaction is:

$$2\,Al + 3\,CuCl_2 \rightarrow 3\,Cu + 2\,AlCl_3$$

Calculate the maximum mass of copper produced in grams (g).

You should determine the limiting reactant.

Relative atomic masses (A_r): Al = 27 Cu = 63.5

Relative formula masses (M_r): $CuCl_2$ = 134.5 $AlCl_3$ = 133.5

[6 marks]

Limiting reactant is _____

Mass of copper = _____ g

Question 7 continues on the next page

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 03 · continued

Sodium metal and sodium chloride are both able to conduct electricity.

0 7 . 5 Describe how sodium metal conducts electricity.

[2 marks]

0 7 . 6 Explain how sodium chloride can conduct electricity.

[3 marks]

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5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 04

0 4 This question is about metals.

0 4 . 1 Iron is extracted from iron oxide by reduction with carbon.

Why can iron be extracted by reduction with carbon?

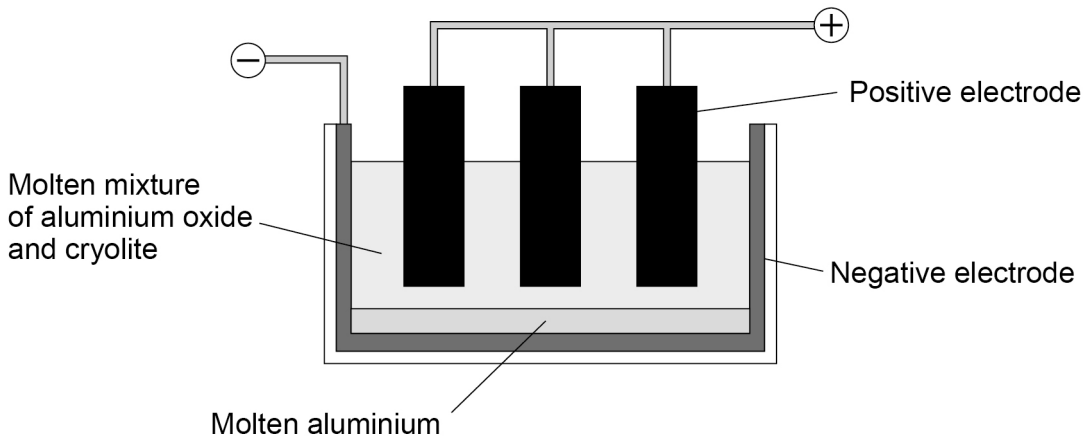
Answer in terms of reactivity.

[1 mark]

Aluminium is extracted by the electrolysis of aluminium oxide.

Figure 4 shows the apparatus used to extract aluminium.

Figure 4



5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 04 · continued

0 4 . 2 Explain why a mixture of aluminium oxide and cryolite is used as the electrolyte instead of only aluminium oxide.

[2 marks]

0 4 . 3 Oxygen gas is produced at the positive electrode.

Write a balanced half equation for the production of oxygen at the positive electrode.

[2 marks]

_____ → _____ + _____

Question 4 continues on the next page

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 04 · continued

Chromium is extracted by reacting chromium oxide with aluminium.

The equation for the reaction is:

$$Cr_2O_3 + 2\,Al \rightarrow Al_2O_3 + 2\,Cr$$

0 4 . 4 Which substance in the equation is reduced?

[1 mark]

Table 3 shows the relative cost of extracting equal masses of aluminium, chromium and iron.

Table 3

Metal	Relative cost of extraction
Aluminium	2
Chromium	20
Iron	1

0 4 . 5 Give **one** reason for the difference in the cost of extracting aluminium and **iron**.

Use **Table 3**.

[1 mark]

5.4.1.4 Oxidation and reduction in terms of electrons (HT only)

Question 04 · continued

0 4 . 6 Give **one** reason for the difference in the cost of extracting aluminium and **chromium**.

Use **Table 3**.

[1 mark]

0 4 . 7 Metals are mixed together to form alloys.

Explain why alloys are harder than pure metals.

[3 marks]

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