AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.3.5

# Representation of reactions at electrodes as half equations (HT only)

## Past-paper questions

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **13** |
| Available paper years | **2011–2025** |

## 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:** _____

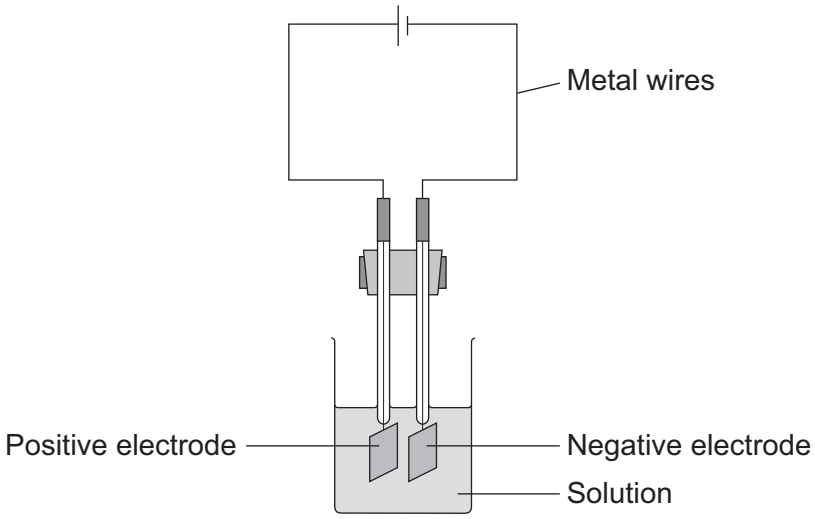
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

**Question 01**

June 2011 | CHY2H | Original Q5 | Legacy

**5** The diagram shows apparatus used by a student to investigate electrolysis.




The student was given a solution by the teacher. The solution contained a mixture of ionic compounds.

**5 (a)** Name the particles which carry the electric current through:

**5 (a) (i)** the metal wires.....

*(1 mark)*

**5 (a) (ii)** the solution. .....

*(1 mark)*

**5 (b)** The table shows the ions in the solution.

| Positive ions in the solution | Negative ions in the solution |
|---|---|
| Zinc ion ($Zn^{2+}$) | Chloride ion ($Cl^-$) |
| Iron(III) ion ($Fe^{3+}$) | Hydroxide ion ($OH^-$) |
| Hydrogen ion ($H^+$) | Nitrate ion ($NO_3^-$) |
| Copper(II) ion ($Cu^{2+}$) | Sulfate ion ($SO_4^{2-}$) |

The reactivity series on the Data Sheet may help you to answer this question.

**5 (b) (i)** Which element is most likely to be formed at the negative electrode?

.....

*(1 mark)*

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 01 · continued** June 2011 | CHY2H | Original Q5 | Legacy

**5 (b) (ii)** Explain, as fully as you can, why you have chosen this element.

.....

.....

.....

.....

*(2 marks)*

**5 (c)** The electrolysis of sodium chloride solution is an industrial process.

**5 (c) (i)** The reaction at one of the electrodes can be represented by the equation shown below.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

The chloride ions ($Cl^-$) are oxidised.

Explain why.

.....

.....

*(1 mark)*

**5 (c) (ii)** The reaction at the other electrode can be represented by an equation.

Complete and balance the equation for the reaction at the other electrode.

$$H^+ \rightarrow H_2$$

*(1 mark)*

7

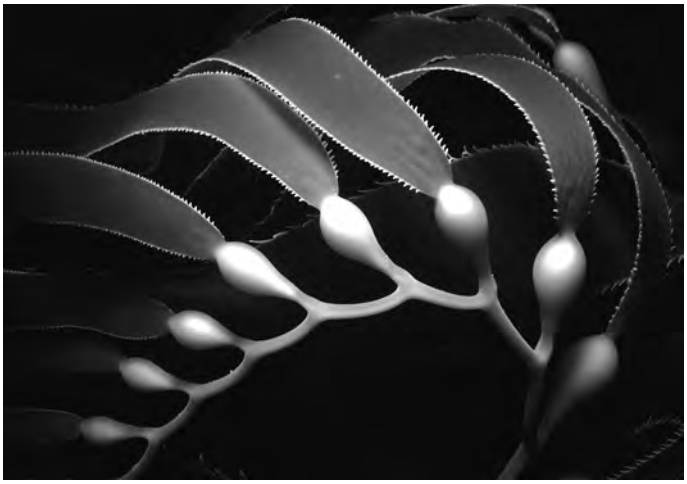
**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 02**

January 2013 | CH2HP | Original Q5 | Legacy

**5** Kelp is a seaweed.

Kelp can be used in foods and as a renewable energy source.



**5 (a)** Scientific experiments, on their own, **cannot** fully answer one of the following questions. Which one?

Tick (✓) **one** box.

| Questions | Tick (✓) |
|---|---|
| How much carbon dioxide is produced when 100 g of kelp is burned? | |
| Does kelp give out more heat energy than coal? | |
| Will kelp last longer than coal as an energy source? | |
| Which fuel, kelp or coal, produces the most ash when burned? | |

*(1 mark)*

**5 (b)** Scientists cannot answer the question 'should people use kelp instead of coal as an energy source?'

Give **two** reasons why.

.....

.....

.....

.....

*(2 marks)*

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 02 · continued



**5 (c)** Sodium iodide can be produced from kelp.

**5 (c) (i)** How many electrons are in the outer shell of an iodine atom?

*(1 mark)*

**5 (c) (ii)** Sodium iodide contains sodium ions ($Na^+$) and iodide ions ($I^-$).

Describe, as fully as you can, what happens when sodium atoms react with iodine atoms to produce sodium iodide.

You may use a diagram in your answer

.....

.....

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.....

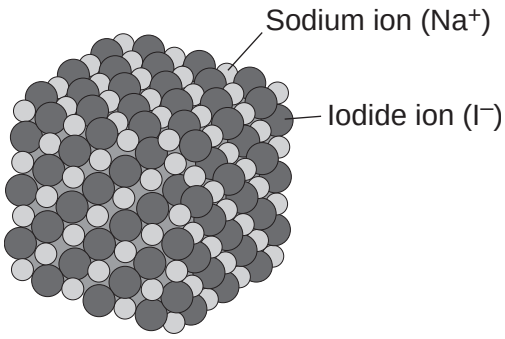
*(3 marks)*

**Question 5 continues on the next page**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 02 · continued** January 2013 | CH2HP | Original Q5 | Legacy

**5 (c) (iii)** The diagram shows the structure of sodium iodide.




Solid sodium iodide does not conduct electricity.

Why does sodium iodide solution conduct electricity?

.....

.....

*(1 mark)*

**5 (c) (iv)** When sodium iodide solution is electrolysed, iodine is formed at the positive electrode.

Complete and balance the half equation for the formation of iodine.

..... $I^-$ → $I_2$ + ..... $e^-$

*(1 mark)*

**5 (c) (v)** What is formed at the negative electrode when sodium iodide solution is electrolysed?

Explain why.

.....

.....

.....

.....

*(2 marks)*

11

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

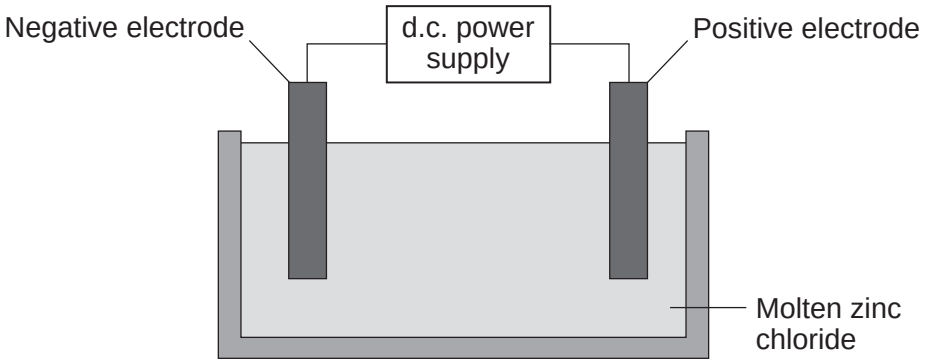
**Question 03**

June 2014 | CH2HP | Original Q4 | Legacy

**4** This question is about zinc and magnesium.

Zinc is produced by electrolysis of molten zinc chloride, as shown in **Figure 4**.

**Figure 4**




**4 (a) (i)** Why must the zinc chloride be molten for electrolysis?

**[1 mark]**

.....

.....

**4 (a) (ii)** Describe what happens at the negative electrode.

**[3 marks]**

.....

.....

.....

.....

.....

.....

**4 (a) (iii)** Complete the half equation for the reaction at the positive electrode.

**[1 mark]**

..... $\longrightarrow$ $Cl_2$ + ..... $e^-$

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 03 · continued** June 2014 | CH2HP | Original Q4 | Legacy

**4 (b)** Magnesium can be produced from magnesium oxide.

The equation for the reaction is:

$$Si(s) + 2\,MgO(s) \rightleftharpoons SiO_2(s) + 2\,Mg(g)$$

**4 (b) (i)** How can you tell from the equation that the reaction is done at a high temperature?

**[1 mark]**

.....

.....

**4 (b) (ii)** This reaction to produce magnesium from magnesium oxide is **endothermic**.

What is meant by an **endothermic** reaction?

**[1 mark]**

.....

.....

**4 (b) (iii)** A company made magnesium using this reaction.

Calculate the mass of magnesium oxide needed to produce 1.2 tonnes of magnesium.

Relative atomic masses ($A_r$): O = 16; Mg = 24

**[3 marks]**

.....

.....

.....

.....

Mass of magnesium oxide needed = ..... tonnes

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 03 · continued** June 2014 | CH2HP | Original Q4 | Legacy

**4 (b) (iv)** The company calculated that they would produce 1.2 tonnes of magnesium, but only 0.9 tonnes was produced.

Calculate the percentage yield.

**[1 mark]**

.....

.....

Percentage yield = ..... %

**4 (b) (v)** Give **one** reason why the calculated yield of magnesium might not be obtained.

**[1 mark]**

.....

.....

12

**Turn over for the next question**

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

**Question 04**

June 2016 | CH2HP | Original Q5 | Legacy

**5** This question is about magnesium and magnesium chloride.

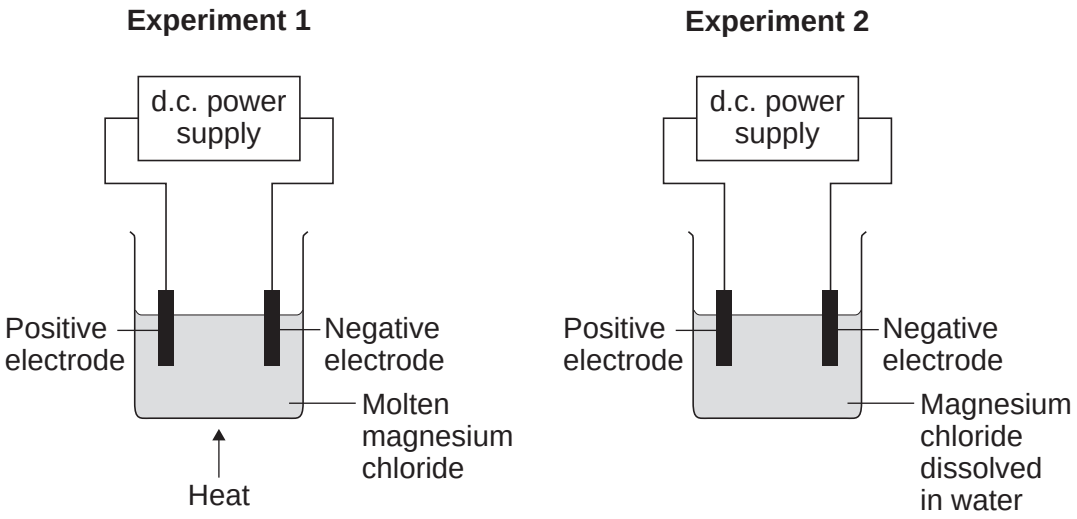
**5 (a)** Magnesium chloride contains magnesium ions ($Mg^{2+}$) and chloride ions ($Cl^-$).

Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.

**[4 marks]**

**5 (b)** Magnesium chloride can be electrolysed.
**Figure 5** shows two experiments for electrolysing magnesium chloride.

**Figure 5**



4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 04 · continued



**5 (b) (i)** Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

**[2 marks]**

**5 (b) (ii)** Explain how magnesium is produced at the negative electrode in **Experiment 1**.

**[3 marks]**

**5 (b) (iii)** In **Experiment 2** a gas is produced at the negative electrode.
Name the gas produced at the negative electrode.

**[1 mark]**

**5 (b) (iv)** Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

**[1 mark]**

**Question 5 continues on the next page**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 04 · continued**



**5 (b) (v)** Complete and balance the half equation for the reaction at the positive electrode.

**[1 mark]**




**5 (c)** Magnesium is a metal.
Explain why metals can be bent and shaped.

**[2 marks]**

_____

_____

_____

_____

14

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 05**



**6** This question is about sodium chloride.

**6 (a)** A student reacted hydrochloric acid and sodium hydroxide solution to produce sodium chloride solution.

The student:

- measured 50 $cm^3$ of hydrochloric acid into a glass beaker
- measured the initial temperature of the hydrochloric acid
- added 50 $cm^3$ of sodium hydroxide solution
- stirred the mixture and measured the highest temperature of the solution.

**6 (a) (i)** The hydrochloric acid and sodium hydroxide solution were the same concentration.

Suggest **one** reason why the temperature change could be greater than expected.

**[1 mark]**

Tick (✓) **one** box.

The volume of the sodium hydroxide solution was more than 50 $cm^3$. ☐

The volume of the hydrochloric acid was more than 50 $cm^3$. ☐

The initial temperature reading was too low. ☐

The highest temperature reading was too low. ☐

**6 (a) (ii)** The student did the investigation three times.

**Table 2** shows the results.

**Table 2**

| Experiment number | Initial temperature of the acid in °C | Highest temperature of solution in °C |
|---|---|---|
| **1** | 20 | 33 |
| **2** | 19 | 30 |
| **3** | 20 | 32 |

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 05 · continued**



What conclusion can you make about the reaction from the results in **Table 2**?

**[1 mark]**

**6 (b)** The student electrolysed sodium chloride solution.

**6 (b) (i)** Explain what happens at the negative electrode and why sodium is **not** produced.

**[3 marks]**

**6 (b) (ii)** Chlorine gas is produced at the positive electrode.
Complete the half equation.

**[1 mark]**

$$____\ Cl^- \longrightarrow _____ + _____$$

**6 (b) (iii)** Explain why the pH of the solution after electrolysis was 14

**[2 marks]**

8

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

**Question 06**

June 2018 | 8462/1H | Original Q8

**0 8** Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two stage industrial process.

**Stage 1** $TiO_2 + 2\,C + 2\,Cl_2 \rightarrow TiCl_4 + 2\,CO$

**Stage 2** $TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$

**0 8 . 1** Suggest **one** hazard associated with **Stage 1**.

**[1 mark]**

**0 8 . 2** Water must be kept away from the reaction in **Stage 2**.

Give **one** reason why it would be hazardous if water came into contact with sodium.

**[1 mark]**

**0 8 . 3** Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon and **not** in air.

**[2 marks]**

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 06 · continued



**0 8 . 4** Titanium chloride is a liquid at room temperature.

Explain why you would **not** expect titanium chloride to be a liquid at room temperature.

**[3 marks]**

In **Stage 2**, sodium displaces titanium from titanium chloride.

**0 8 . 5** Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction?

**[1 mark]**

**0 8 . 6** Complete the half equation for the oxidation reaction.

**[1 mark]**

Na → _____ + _____

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 06 · continued**



**0 8 . 7** In **Stage 2**, 40 kg of titanium chloride was added to 20 kg of sodium.

The equation for the reaction is:

$$TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$$

Relative atomic masses ($A_r$): Na = 23 Cl = 35.5 Ti = 48

Explain why titanium chloride is the limiting reactant.

You **must** show your working.

**[4 marks]**

**0 8 . 8** For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced.

**[2 marks]**

Mass of titanium = _____ kg

**15**

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

**Question 07**

June 2019 | 8462/1H | Original Q7

**0 7** This question is about electrolysis.

Aluminium is produced by electrolysing a molten mixture of aluminium oxide and cryolite.

**0 7 . 1** Explain why a mixture is used as the electrolyte instead of using only aluminium oxide.

**[2 marks]**

**0 7 . 2** What happens at the negative electrode during the production of aluminium?

**[1 mark]**

Tick (✓) **one** box.

- Aluminium atoms gain electrons. ☐
- Aluminium atoms lose electrons. ☐
- Aluminium ions gain electrons. ☐
- Aluminium ions lose electrons. ☐

**0 7 . 3** Oxygen is produced at the positive electrode.

Complete the balanced half-equation for the process at the positive electrode.

**[2 marks]**

$\rightarrow \quad O_2 \quad +$

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 07 · continued** June 2019 | 8462/1H | Original Q7

**0 7 . 4** Explain why the positive electrode must be continually replaced.

**[3 marks]**

**0 7 . 5** The overall equation for the electrolysis of aluminium oxide is:

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

Calculate the mass of oxygen produced when 2000 kg of aluminium oxide is completely electrolysed.

Relative atomic masses ($A_r$): O = 16 Al = 27

**[4 marks]**

Mass of oxygen = _____ kg

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 07 · continued



Sodium metal and chlorine gas are produced by the electrolysis of molten sodium chloride.

**0 7 . 6** Explain why sodium chloride solution **cannot** be used as the electrolyte to produce sodium metal.

**[2 marks]**

**0 7 . 7** Calculate the volume of 150 kg of chlorine gas at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 $dm^3$

Relative formula mass ($M_r$): $Cl_2$ = 71

**[2 marks]**

Volume = _____ $dm^3$

16

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 08

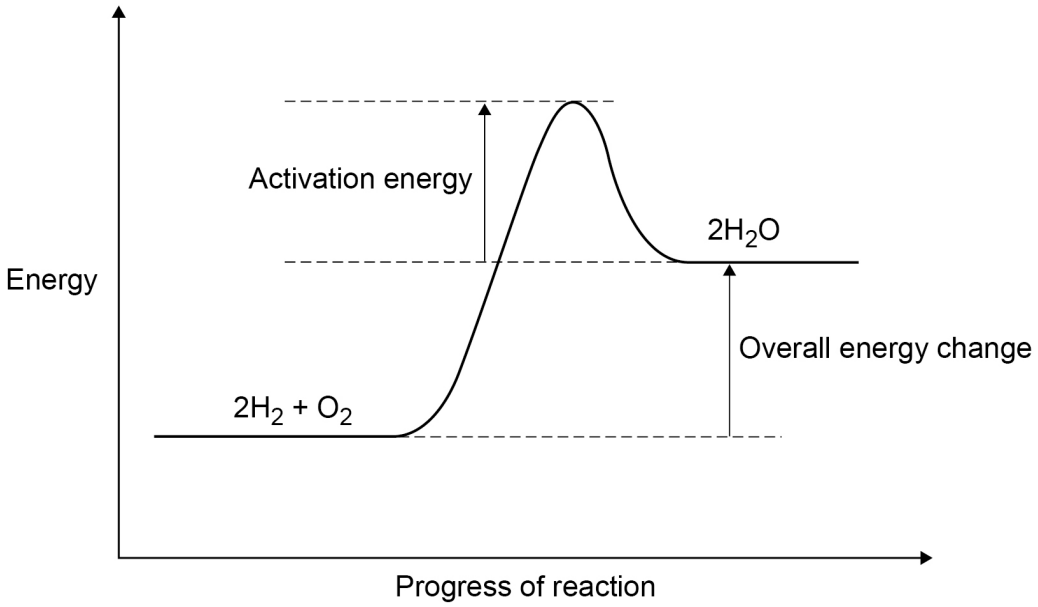
November 2020 | 8462/1H | Original Q7

**0 7** The reaction between hydrogen and oxygen releases energy.

**0 7 . 1** A student drew a reaction profile for the reaction between hydrogen and oxygen.

**Figure 3** shows the student's reaction profile.

**Figure 3**




The student made **two** errors when drawing the reaction profile.

Describe the **two** errors.

**[2 marks]**

1 _____

_____

2 _____

_____

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 08 · continued



**0 7 . 2** The reaction between hydrogen and oxygen in a hydrogen fuel cell is used to produce electricity.

Hydrogen fuel cells and rechargeable cells are used to power some cars.

Give **two** advantages of using hydrogen fuel cells instead of using rechargeable cells to power cars.

**[2 marks]**

1 _____

_____

2 _____

_____

**0 7 . 3** Reactions occur at the positive electrode and at the negative electrode in a hydrogen fuel cell.

Write a half equation for **one** of these reactions.

**[1 mark]**

_____

**Question 7 continues on the next page**

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

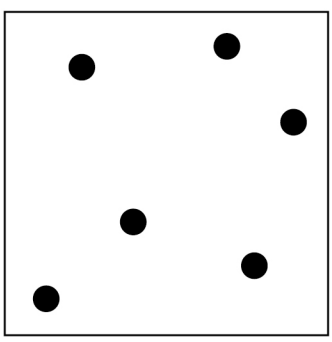
Question 08 · continued



**0 7 . 4** The three states of matter can be represented by a simple particle model.

**Figure 4** shows a simple particle model for hydrogen gas.

**Figure 4**



Give **two** limitations of this simple particle model for hydrogen gas.

**[2 marks]**

1 _____

_____

2 _____

_____

**0 7 . 5** The hydrogen gas needed to power a car for 400 km would occupy a large volume.

Suggest **one** way that this volume can be reduced.

**[1 mark]**

_____

_____

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 08 · continued**



**0 7 . 6** The energy needed for a car powered by a hydrogen fuel cell to travel 100 km is 58 megajoules (MJ).

The energy released when 1 mole of hydrogen gas reacts with oxygen is 290 kJ

The volume of 1 mole of a gas at room temperature and pressure is 24 $dm^3$

Calculate the volume of hydrogen gas at room temperature and pressure needed for the car to travel 100 km

**[4 marks]**

Volume of hydrogen gas = _____ $dm^3$

**12**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 09**



**0 7** This question is about chemical reactions and electricity.

**0 7 . 1** Electrolysis and chemical cells both involve chemical reactions and electricity.

Explain the difference between the processes in electrolysis and in a chemical cell.

**[2 marks]**

**0 7 . 2** A teacher demonstrates the electrolysis of molten lead bromide.

Bromine is produced at the positive electrode.

Complete the half equation for the production of bromine.

You should balance the half equation.

**[2 marks]**

$$Br^- \rightarrow \quad + \quad$$

**0 7 . 3** Two aqueous salt solutions are electrolysed using inert electrodes.

Complete **Table 4** to show the product at each electrode.

**[3 marks]**

**Table 4**

| Salt solution | Product at positive electrode | Product at negative electrode |
|---|---|---|
| Copper nitrate | | copper |
| Potassium iodide | | |

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

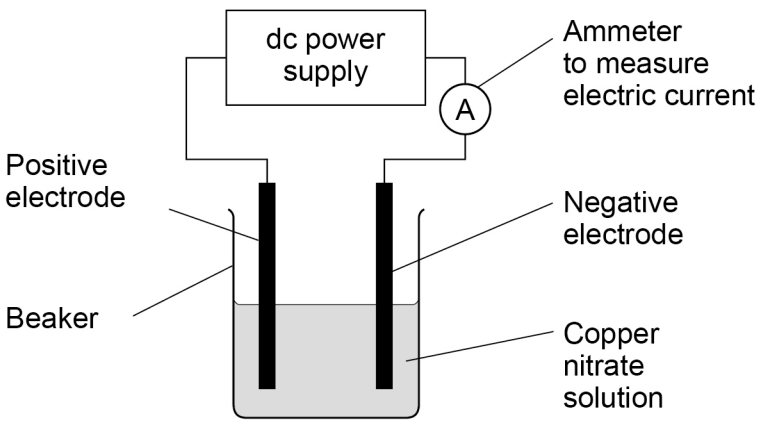
Question 09 · continued



Some students investigated the electrolysis of copper nitrate solution using inert electrodes.

**Figure 4** shows the apparatus.

**Figure 4**




The students investigated how the mass of copper produced at the negative electrode varied with:

- time
- current.

This is the method used.

1. Weigh the negative electrode.
2. Set up the apparatus shown in **Figure 4**.
3. Adjust the power supply until the ammeter shows a current of 0.3 A
4. Switch off the power supply after 5 minutes.
5. Rinse the negative electrode with water and allow to dry.
6. Reweigh the negative electrode.
7. Repeat steps 1 to 6 for different times.
8. Repeat steps 1 to 7 at different currents.

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 09 · continued**



**0 7 . 4** Some of the copper produced did not stick to the negative electrode but fell to the bottom of the beaker.

Suggest how the students could find the total mass of copper produced.

**[4 marks]**

**Question 7 continues on the next page**

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

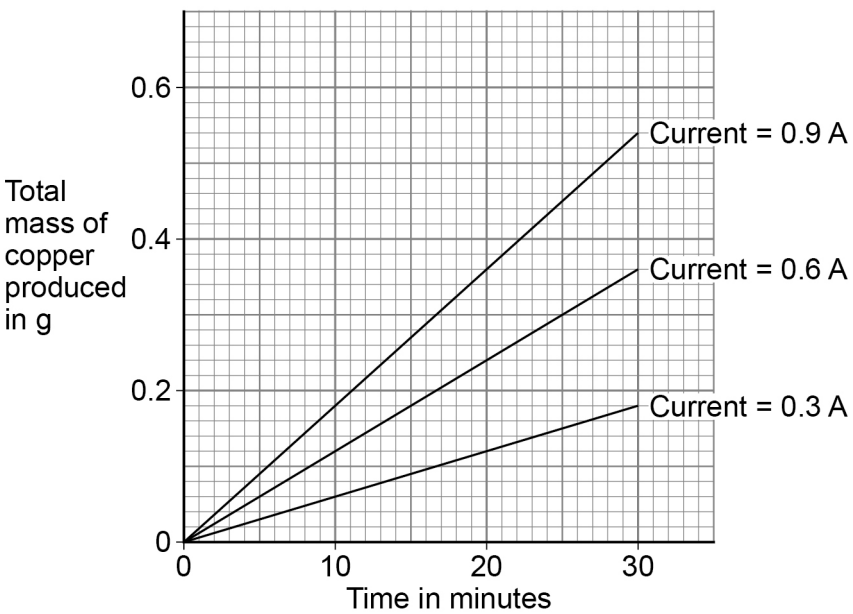
Question 09 · continued



The students plotted their results on a graph.

**Figure 5** shows the graph.

**Figure 5**




A student correctly concluded that the total mass of copper produced is directly proportional both to the time and to the current.

**0 7 . 5** How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the time?

**[1 mark]**

**0 7 . 6** How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the current?

Use data from **Figure 5** in your answer.

**[1 mark]**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 09 · continued**



**0 7 . 7** Copper nitrate solution is blue.

Suggest why the blue colour of the copper nitrate solution fades during the electrolysis.

**[1 mark]**

**0 7 . 8** Determine the number of atoms of copper produced when copper nitrate solution is electrolysed for 20 minutes at a current of 0.6 A

Give your answer to 3 significant figures.

Use **Figure 5**.

Relative atomic mass ($A_r$): Cu = 63.5

The Avogadro constant = $6.02 \times 10^{23}$ per mole

**[3 marks]**

Number of atoms (3 significant figures) = _____

17

### 4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

**Question 10**

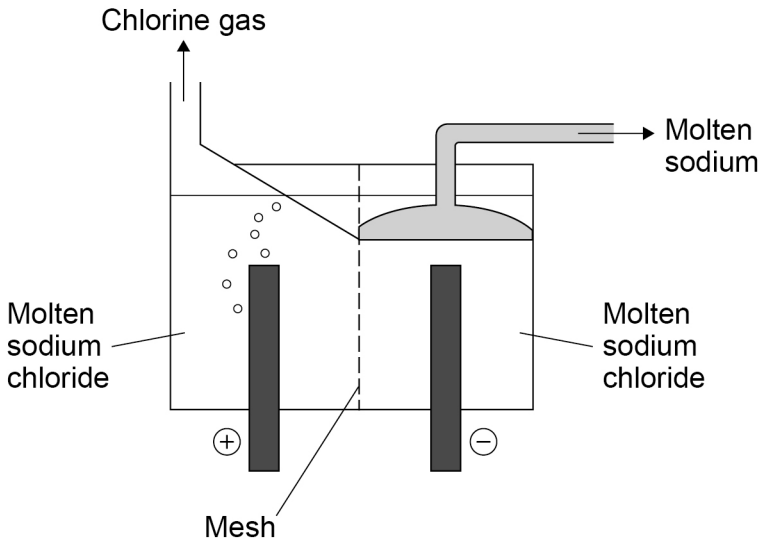
June 2022 | 8462/1H | Original Q6

**0 6** This question is about electrolysis.

Molten sodium chloride is electrolysed in an industrial process to produce sodium.

**Figure 8** shows a simplified version of the electrolysis cell used.

**Figure 8**




**0 6 . 1** Which is the correct half equation for the production of sodium?

**[1 mark]**

Tick (✓) **one** box.

$Na + e^- \rightarrow Na^+$ ☐

$Na \rightarrow Na^+ + e^-$ ☐

$Na^+ + e^- \rightarrow Na$ ☐

$Na^+ \rightarrow Na + e^-$ ☐

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 10 · continued



A mesh is used to keep the products of the electrolysis apart.

**0 6 . 2** Suggest **one** reason why the products of the electrolysis must be kept apart.

**[1 mark]**

**0 6 . 3** Which type of particle passes through the mesh in the electrolysis of molten sodium chloride?

**[1 mark]**

Tick (✓) **one** box.

- Atom ☐
- Electron ☐
- Ion ☐
- Molecule ☐

**Question 6 continues on the next page**

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 10 · continued



Aqueous sodium chloride solution is electrolysed in a different industrial process.

Two gases and an alkaline solution are produced.

**0 6 . 4** Which **two** ions are present in aqueous sodium chloride solution in addition to sodium ions and chloride ions?

**[2 marks]**

1 _____

2 _____

**0 6 . 5** Name the alkaline solution produced.

**[1 mark]**

_____

**0 6 . 6** Explain how the alkaline solution is produced.

You should refer to the processes at the electrodes.

**[3 marks]**

_____

_____

_____

_____

_____

_____

9

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 11**

June 2023 | 8462/1H | Original Q7

**0 7** This question is about electrolysis.

Aluminium is manufactured by electrolysing a molten mixture of aluminium oxide ($Al_2O_3$) and cryolite ($Na_3AlF_6$).

**0 7 . 1** Complete the half equation for the reaction occurring at the negative electrode.

**[1 mark]**

$$Al^{3+} + ____ e^- \rightarrow Al$$

**0 7 . 2** Cryolite contains $Na^+$ ions as well as $Al^{3+}$ ions.

Suggest **one** reason why sodium is **not** a product of the electrolysis.

**[1 mark]**

**Question 7 continues on the next page**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

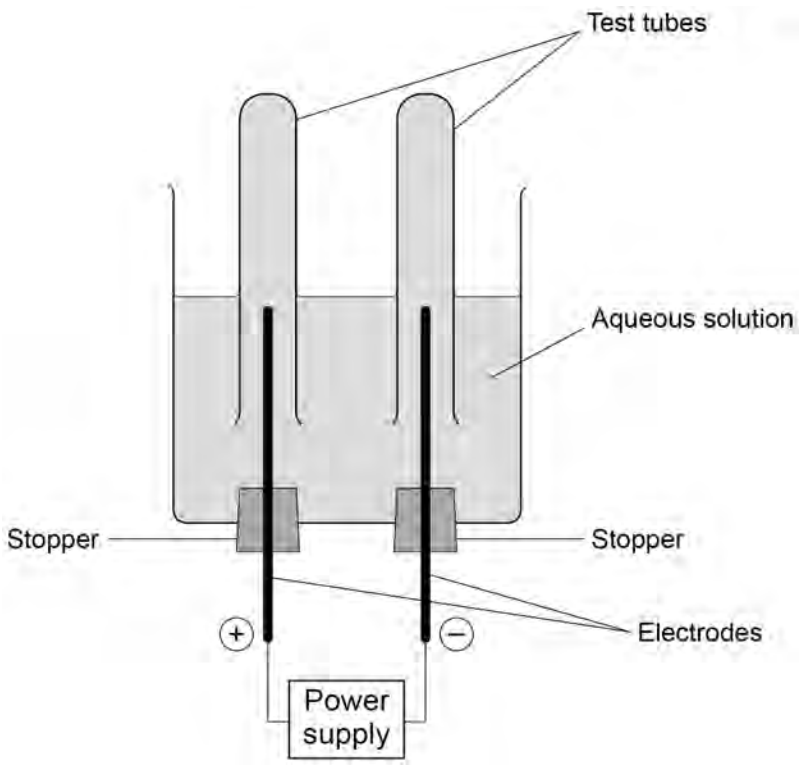
**Question 11 · continued**



A student investigated the electrolysis of an aqueous solution of a different compound.

**Figure 7** shows the apparatus.

**Figure 7**



4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 11 · continued



Hydrogen was produced at the negative electrode and oxygen was produced at the positive electrode.

**0 7 . 3** Explain how oxygen was produced from water during the electrolysis of this aqueous solution.

**[4 marks]**

**0 7 . 4** The student compared the volumes of the two gases collected.

How can the student change the apparatus in **Figure 7** to compare the volumes of the two gases produced more accurately?

Give **one** reason for your answer.

**[2 marks]**

Change _____

Reason _____

**0 7 . 5** The overall equation for the reaction is:

$$2\,H_2O(l) \rightarrow 2\,H_2(g) + O_2(g)$$

What is the volume of oxygen produced when 20 $cm^3$ of hydrogen has been produced?

**[1 mark]**

Tick (✓) **one** box.

10 $cm^3$ ☐ 20 $cm^3$ ☐ 30 $cm^3$ ☐ 40 $cm^3$ ☐

9

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 12**

June 2024 | 8462/1H | Original Q5

**0 5** This question is about ionic compounds and electrolysis.

Calcium chloride is an ionic compound.

**0 5 . 1** Calcium and chlorine react to produce calcium chloride.

Describe what happens to calcium atoms and chlorine atoms when the ionic compound calcium chloride is formed.

**[4 marks]**

**0 5 . 2** Solid calcium chloride **cannot** be electrolysed.

Give **one** reason why.

**[1 mark]**

**0 5 . 3** Name the product formed at the negative electrode when aqueous calcium chloride solution is electrolysed.

**[1 mark]**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 12 · continued**



**0 5 . 4** What is the half equation for the reaction at the positive electrode when aqueous calcium chloride solution is electrolysed?

**[1 mark]**

Tick (✓) **one** box.

$2Cl^- \rightarrow Cl_2 + 2e^-$ ☐

$Cl_2 + 2e^- \rightarrow 2Cl^-$ ☐

$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ ☐

$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ ☐

**Question 5 continues on the next page**

4.4.3.5 Representation of reactions at electrodes as half equations (HT only)

Question 12 · continued



**0 5 . 5** A student investigated the electrolysis of green copper chromate solution.

**Figure 4** shows the apparatus.

**Figure 4**

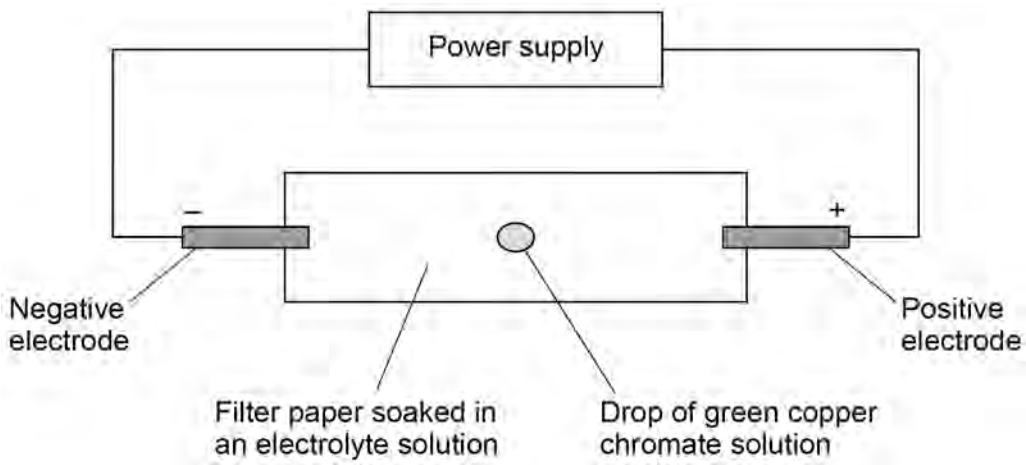
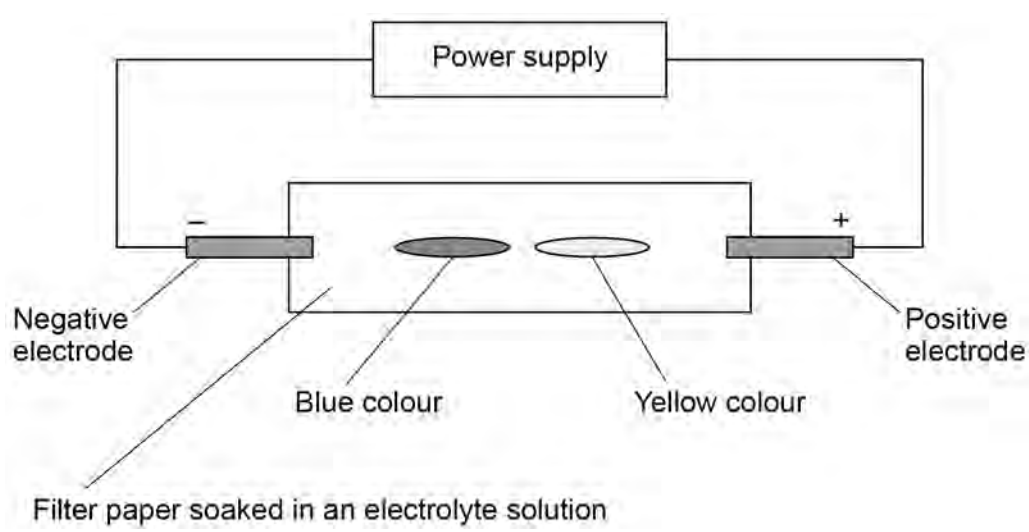



**Figure 5** shows the results.

**Figure 5**



**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 12 · continued**



Copper chromate solution contains the ions $Cu^{2+}$ and $CrO_4^{2-}$

Explain the results shown in **Figure 5**.

**[3 marks]**

10

**Turn over for the next question**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 13**

June 2025 | 8462/1H | Original Q6

**0 6** Aluminium is extracted by the electrolysis of a molten mixture.

The mixture contains aluminium oxide and one other substance.

**0 6 . 1** Aluminium oxide is an ionic compound.

Explain why aluminium oxide has a very high melting point.

**[4 marks]**

Extra space

**0 6 . 2** Name the substance added to aluminium oxide to form the mixture.

**[1 mark]**

**0 6 . 3** Give **one** reason why a mixture is used as the electrolyte.

**[1 mark]**

**4.4.3.5 Representation of reactions at electrodes as half equations (HT only)**

**Question 13 · continued** June 2025 | 8462/1H | Original Q6

Oxygen is produced at the positive electrode.

**0 6 . 4** Write the half equation for the reaction that produces oxygen at the positive electrode.

**[2 marks]**

_____ → _____ + _____

**0 6 . 5** The positive electrode must be continually replaced.

Explain why.

**[3 marks]**

_____

_____

_____

_____

_____

_____

**11**