

# REDOX REACTIONS AND ELECTROLYSIS 2

**Q1.** A student investigated the electrolysis of copper sulfate solution.

The student's method is shown in the box.

Two clean pieces of copper were weighed. One piece was used as the positive electrode and the other piece was used as the negative electrode.

The circuit was set up as shown in the diagram.

After the electrolysis, the pieces of copper were:

- washed with distilled water
- washed with propanone (a liquid with a lower boiling point than water)
- allowed to dry
- weighed.

**(a)** Explain why the electrode would dry faster when washed with propanone instead of water.

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(1 mark)

(b) The student's results are given in the table.

	Positive electrode	Negative electrode
mass of electrode before electrolysis, in grams	16.41	15.46
mass of electrode after electrolysis, in grams	16.10	15.75

The mass of the positive electrode decreased by 0.31 g.

(i) What is the change in mass of the negative electrode?

\_\_\_\_\_

(1 mark)

(ii) The mass lost by the positive electrode should equal the mass gained by the negative electrode.

Suggest two reasons why the results were not as expected.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2 marks)

(c) Describe and explain how electrolysis is used to make pure copper from a lump of impure copper.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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(4 marks)

**Q2.** Hydrogen is produced at the negative electrode during the electrolysis of potassium hydroxide solution.

**(i)** Why are hydrogen ions attracted to the negative electrode?

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(1 mark)

**(ii)** Potassium ions are also attracted to the negative electrode.

Explain why hydrogen gas is formed but not potassium.

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(1 mark)

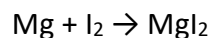
**Q3.** The formation of a lithium ion from a lithium atom is an oxidation reaction. Explain why.

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(1 mark)

**Q4.** Magnesium iodide can be made by reacting magnesium with iodine.



Magnesium iodide is an ionic compound. It contains magnesium ions ( $\text{Mg}^{2+}$ ) and iodide ions ( $\text{I}^-$ ).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

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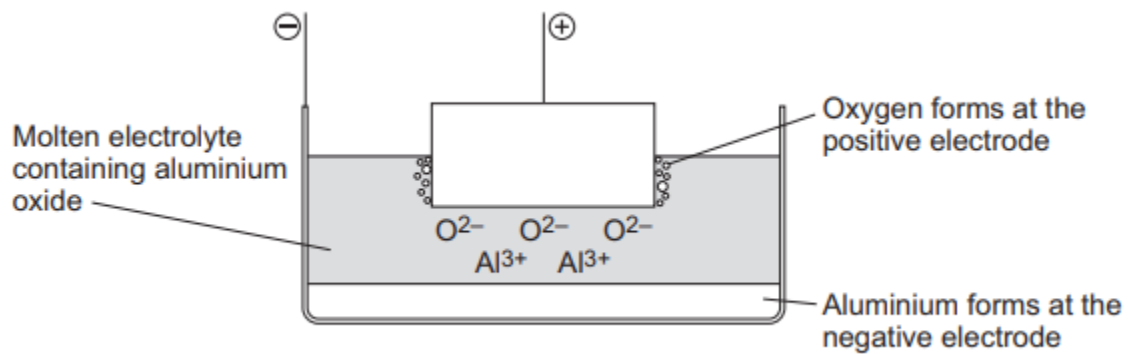
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(4 marks)

**Q5.** The diagram represents an electrolysis cell for extracting aluminium.

The current will only flow when the electrolyte is molten.



**(a)** The electrolyte is aluminium oxide mixed with another substance.

(i) What is the name of the other substance in the electrolyte?

Draw a ring around the correct answer.

**cryolite**

**rock salt**

**limestone**

(1 mark)

(ii) Draw a ring around the correct answer to complete the sentence.

This other substance is added to

condense the aluminium oxide.

lower the melting point of the aluminium oxide.

raise the boiling point of the aluminium oxide.

(1 mark)

(b)(i) Oxide ions ( $O^{2-}$ ) move to the positive electrode.

Explain why.

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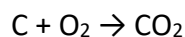
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(2 marks)

(ii) Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.



Complete the sentence.

The name of the element which reacts with oxygen is \_\_\_\_\_.

(1 mark)

(iii) The positive electrode gets smaller.

Suggest why.

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(1 mark)

**Q6.** The electrolysis of sodium chloride solution produces useful substances.

**(a)(i)** Choose a word from the box to complete the sentence.

<b>covalent</b>	<b>ionic</b>	<b>non-metallic</b>
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Electrolysis takes place when electricity passes through \_\_\_\_\_ compounds when they are molten or in solution.

(1 mark)

**(ii)** Choose a word from the box to complete the sentence.

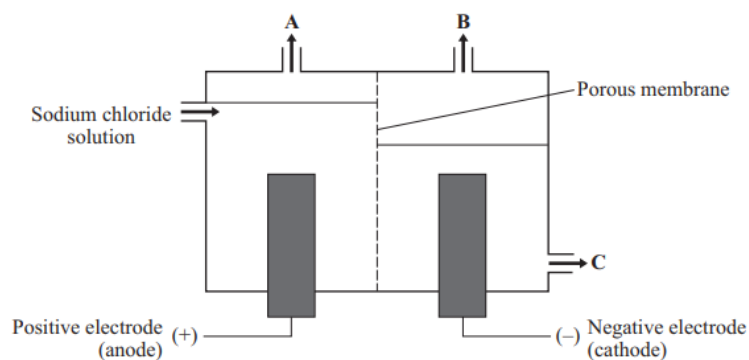
<b>alkenes</b>	<b>elements</b>	<b>salts</b>
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During electrolysis the compound is broken down to form \_\_\_\_\_.

(1 mark)

**(b)** The table of ions may help you to answer this question.

The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



Identify the products **A**, **B** and **C** on the diagram using substances from the box.

chlorine gas	hydrogen gas	oxygen gas
sodium hydroxide solution		sodium metal

(i) A is \_\_\_\_\_.

(1 mark)

(ii) B is \_\_\_\_\_.

(1 mark)

(iii) C is \_\_\_\_\_.

(1 mark)

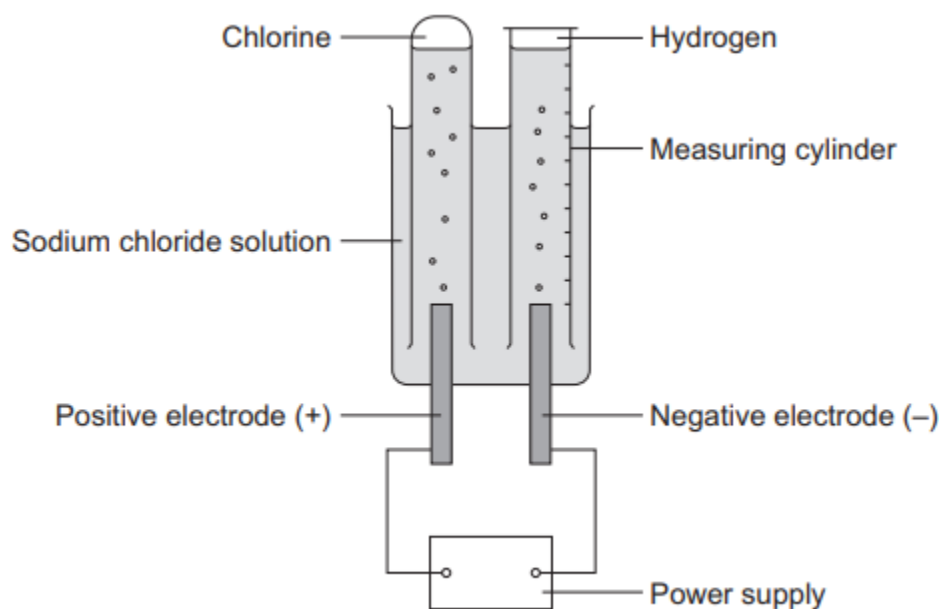
**Q7.** A student investigated the electrolysis of sodium chloride solution.

Five sodium chloride solutions were made. Each solution had a different concentration.

To make each solution the student:

- weighed the amount of sodium chloride needed
- dissolved it in water
- added more water until the total volume was one cubic decimetre (1 dm<sup>3</sup>).

The solutions were placed one at a time in the apparatus shown below.

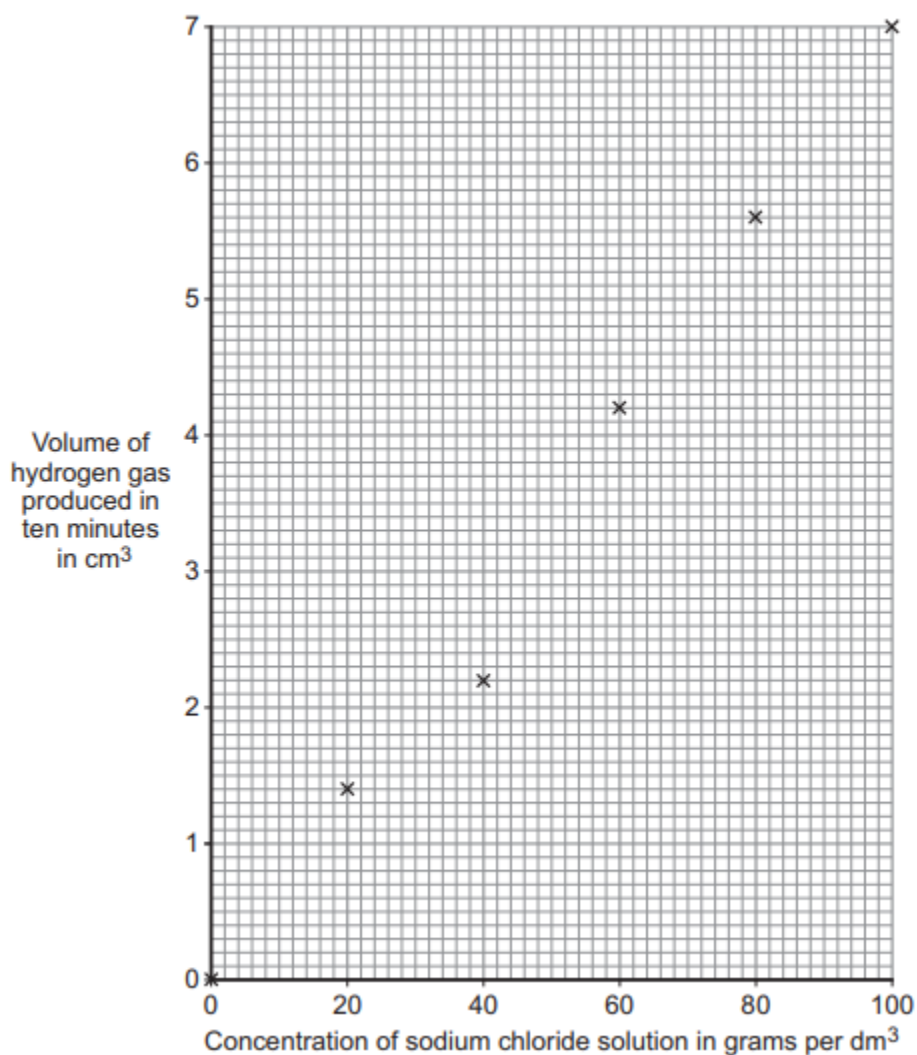


(a) Chlorine is produced at the positive electrode. Why are chloride ions attracted to the positive electrode?

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(1 mark)

(b) The results for the experiment on the previous page are shown on the graph.



(i) Draw a line of best fit on the graph.

(1 mark)

(ii) The result for one concentration is anomalous. Which result is anomalous?

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(1 mark)

**(iii)** Suggest two possible causes of this anomalous result.

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(2 marks)

**(iv)** How did an increase in the concentration of the sodium chloride solution affect the volume of hydrogen gas produced in ten minutes?

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(1 mark)

**Q8.** Fluorine is made in industry by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.

**(i)**

gas	liquid	solid
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To allow electrolysis to take place the mixture of potassium fluoride and hydrogen fluoride must be \_\_\_\_\_.

(1 mark)

**(ii)** The mixture of potassium fluoride and hydrogen fluoride contains fluoride ions ( $F^-$ ), hydrogen ions ( $H^+$ ) and potassium ions ( $K^+$ ).

Use one word from the box to complete the sentence.

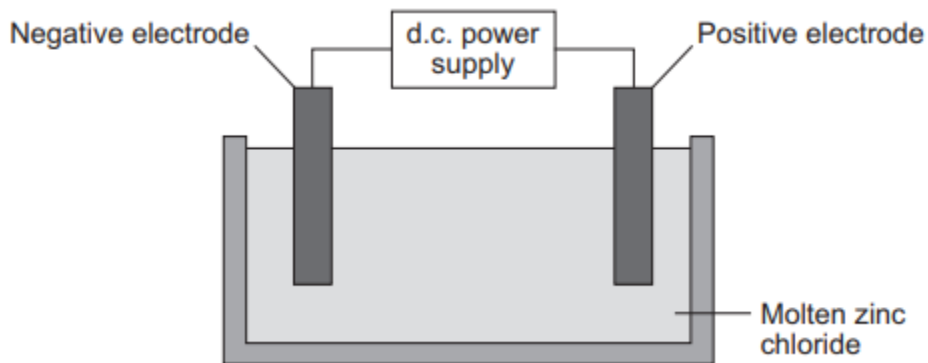
fluorine	hydrogen	potassium
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During electrolysis the element formed at the positive electrode is \_\_\_\_\_.

(1 mark)

**Q9.** This question is about zinc and magnesium.

Zinc is produced by electrolysis of molten zinc chloride, as shown in the figure.



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

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(1 mark)

(ii) Describe what happens at the negative electrode.

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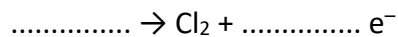
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(3 marks)

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



(1 mark)

Total marks (39)