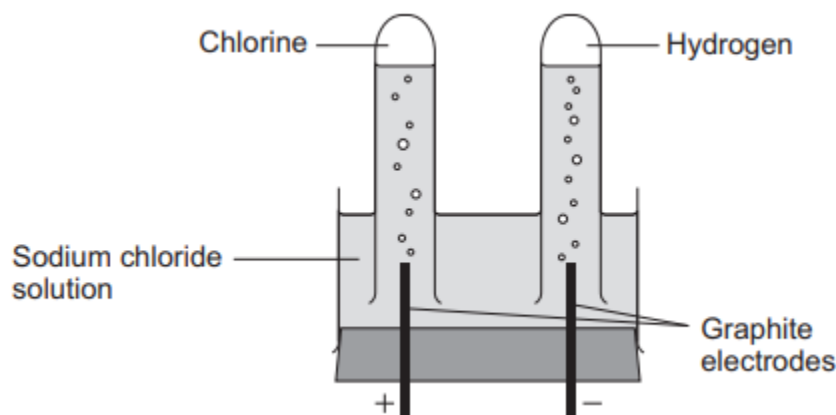


REDOX REACTIONS & ELECTROLYSIS 1

Q1. The electrolysis of sodium chloride solution is an industrial process.

(a) The diagram shows the apparatus used in a school experiment.



One of the products of the electrolysis of sodium chloride solution is hydrogen.

(i) Why do hydrogen ions move to the negative electrode?

(1 mark)

(ii) How does a hydrogen ion change into a hydrogen atom?

(1 mark)

(b) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The electrolysis of sodium chloride solution also produces chlorine and sodium

hydroxide. In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

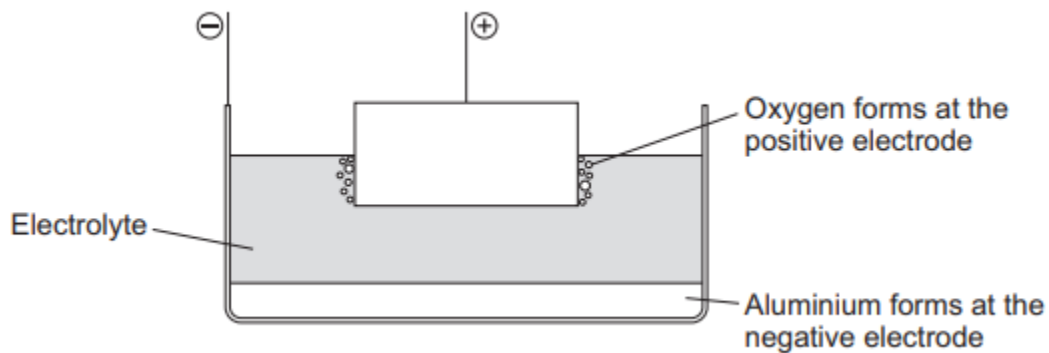
	Mercury cell	Membrane cell
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these two types of electrolysis cell.

(2 marks)

Q3. Aluminium is extracted from aluminium oxide using electrolysis.

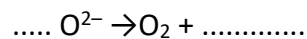
The diagram shows a cell used for the extraction of aluminium.



(i) The electrolyte contains cryolite. Explain why.

(2 marks)

(ii) Oxygen is formed at the positive electrode. Complete and balance the equation for this reaction.



(2 marks)

(iii) The positive electrode in the cell is used up during the process. Explain why.

(2 marks)

Q4. This question is about potassium.

(a) Humphrey Davy was a professor of chemistry.

In 1807 Davy did an electrolysis experiment to produce potassium.

(i) Davy first tried to electrolyse a solid potassium salt to produce potassium.

Explain why this electrolysis did not work.

(2 marks)

(ii) Humphrey Davy was the first person to produce potassium.

Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

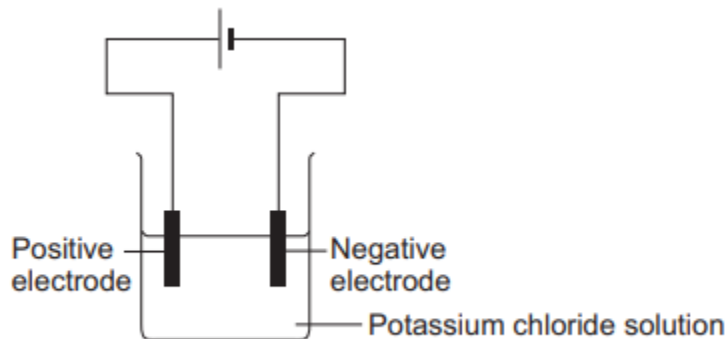
Suggest why.

(1 mark)

(b) A student dissolved some potassium chloride in water.

The student tried to electrolyse the potassium chloride solution to produce potassium.

The apparatus the student used is shown in the diagram.



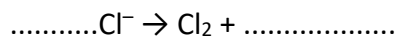
The student expected to see potassium metal at the negative electrode, but instead saw bubbles of a gas.

- Name the gas produced at the negative electrode.
- Explain why this gas was produced at the negative electrode and why potassium was not produced.

The reactivity series of metals may help you to answer this question.

(3 marks)

(c) Complete and balance the equation for the reaction at the positive electrode.



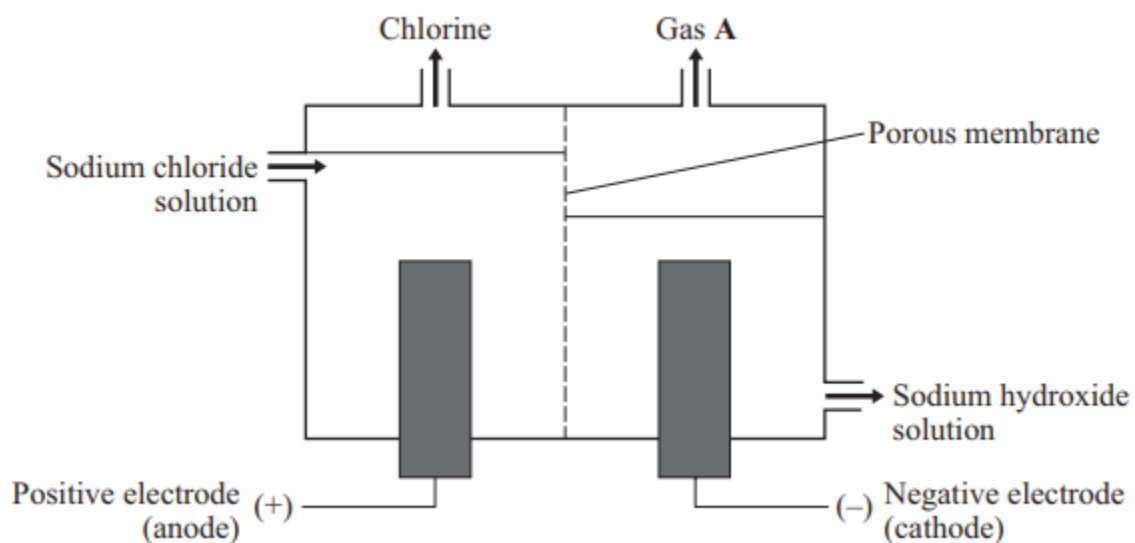
(1 mark)

Q5. The electrolysis of sodium chloride solution produces useful substances.

(a) Explain the meaning of electrolysis.

(2 marks)

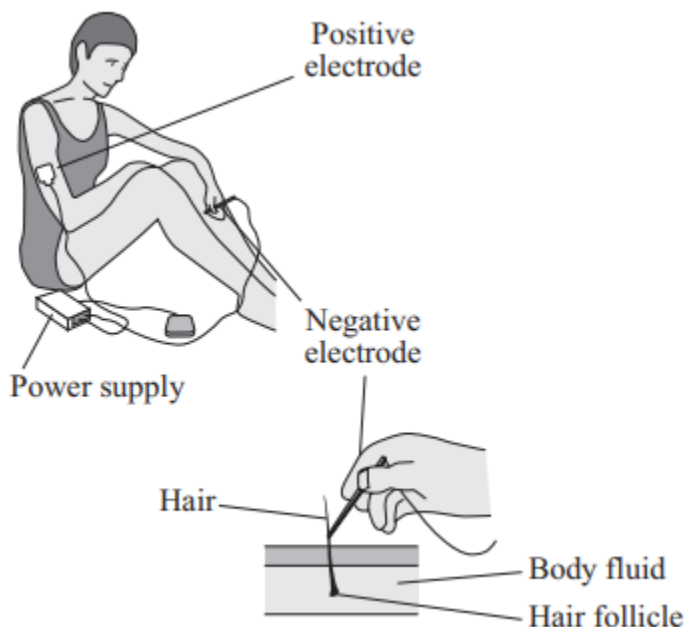
(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



The electrolysis produces two gases, chlorine and Gas **A**. Name Gas **A**.

(1 mark)

Q6. Electrolysis can be used to remove unwanted hair from the skin.



The hair is first coated with a layer of gel containing ions in solution. The positive electrode is connected by a patch to the skin. The negative electrode is connected to the hair. Electricity flows through the gel and causes electrolysis of the body fluid around the hair follicle.

(a) Explain why the gel containing ions in solution can conduct electricity.

(1 mark)

(b) The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

This solution contains hydrogen ions that move to the negative electrode.

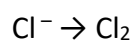
(i) The half equation represents the reaction at the negative electrode.



Explain why this reaction is a reduction.

(1 mark)

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



(1 mark)

Total marks (30)