

Name:

Date:

C4 - Test 6  
CHEMICAL CHANGES  
Advanced

**GCSE**

CHEMISTRY

AQA - Combined Science

Mark

Grade

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### Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

### Instructions

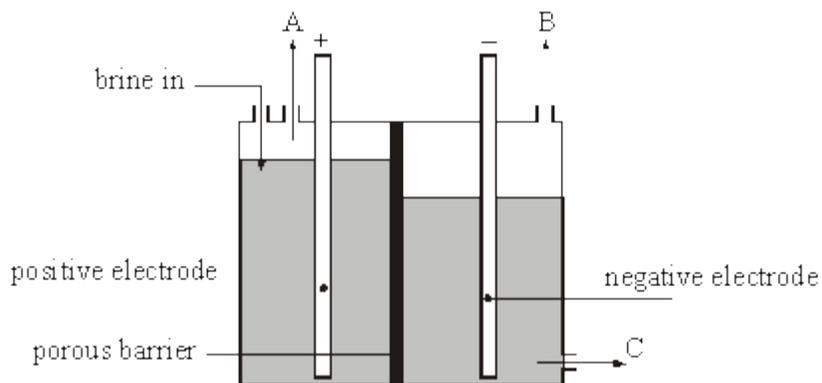
- Answer all questions
- Answer questions in the space provided
- All working must be shown

### Information

- The marks for the questions are shown in brackets

1.

Sodium hydroxide, hydrogen and chlorine can all be made in one industrial process. Electricity is passed through aqueous sodium chloride solution (brine). The diagram below shows a cell that can be used for this process.



(a) Name A, B and C.

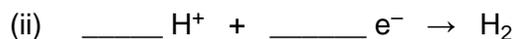
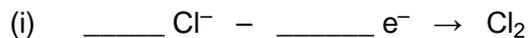
Gas A \_\_\_\_\_

Gas B \_\_\_\_\_

Solution C \_\_\_\_\_

(2)

(b) Balance the equations for the reactions at the electrodes.



(2)

(c) Name the compound in this cell which produces the hydrogen ions.

\_\_\_\_\_

(1)

(d) Which type of particles must be able to pass through the barrier to allow the electrolysis to take place?

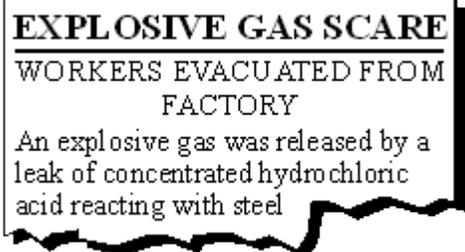
\_\_\_\_\_

(1)

(Total 6 marks)

2.

This article appeared in a newspaper.



- (a) The balanced chemical equation shows the reaction between steel and hydrochloric acid.



- (i) Which metal in steel reacted with the hydrochloric acid?

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(1)

- (ii) The gas released was described as explosive. Explain why.

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(3)

- (b) In the factory hydrogen chloride is manufactured by reacting hydrogen with chlorine. Hydrochloric acid is formed when hydrogen chloride forms a solution in water.

- (i) Water was sprayed on the steel and hydrochloric acid. This slowed the rate of reaction. Explain why.

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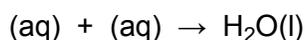
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(2)

- (ii) It would have been better to neutralise the acid with an alkali rather than to just add water. Hydrochloric acid can be neutralised by reaction with sodium hydroxide. Complete the ionic equation for the neutralisation reaction.



(2)

- (iii) In the factory the acid leak was neutralised with slaked lime,  $\text{Ca}(\text{OH})_2$ , and not sodium hydroxide,  $\text{NaOH}$ . Suggest why.

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(2)

(Total 10 marks)

3.

The electrolysis of sodium chloride solution is an important industrial process. Three useful substances are produced:

- chlorine gas is formed at the positive electrode;
- hydrogen gas is formed at the negative electrode;
- an alkali is left in the solution.

The reactions which take place at the electrodes are represented by the equations shown below:



- (a) Name the important alkali which is left in the solution.

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(1)

- (b) State why chloride ions move towards the positive electrode.

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(1)

- (c) Why is the formation of chlorine at this electrode said to be an oxidation reaction?

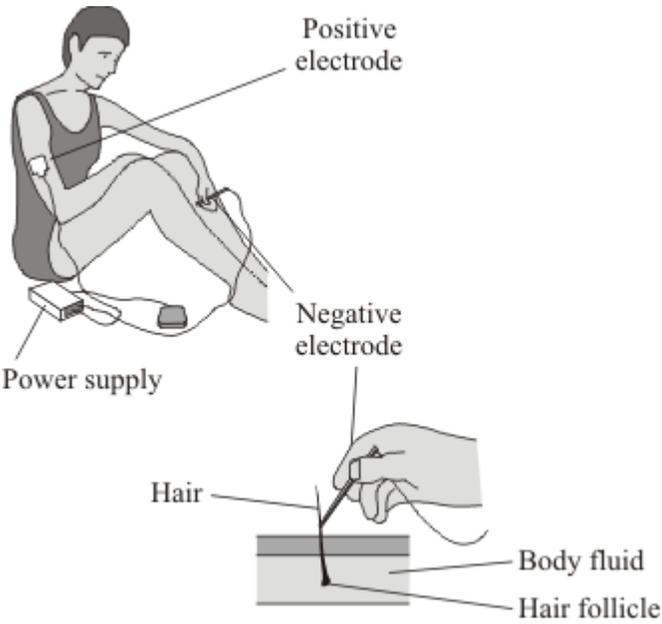
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(1)

(Total 3 marks)

4.

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) Metal wires conduct electricity to the electrodes.

Explain how metals conduct electricity.

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(2)

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

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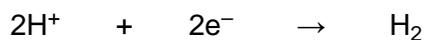
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(1)

- (c) 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.

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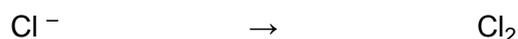
(1)

- (ii) As a result of the electrolysis of sodium chloride solution, an alkali forms which kills the hair follicle.

What is the name of this alkali? \_\_\_\_\_

(1)

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



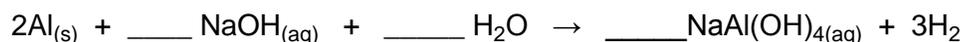
(1)

(Total 6 marks)

5.

Some drain cleaners contain a mixture of sodium hydroxide and powdered aluminium. When the mixture is poured into a drain it mixes with water and a chemical reaction takes place. The heat from the reaction helps to melt grease in the drain. Hydrogen gas is produced which stirs up the particles and helps to unclog the drain.

- (a) Balance the equation for the reaction.



(2)

- (b) Why do the solid sodium hydroxide and aluminium powder **not** react when stored in a sealed container?

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(1)

- (c) Sodium hydroxide is a strong alkali and would react with any acids in the drain.

- (i) Name the ion produced when any alkali is dissolved in water.

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(1)

- (ii) Name the ion produced when any acid is dissolved in water.

\_\_\_\_\_

(1)

- (iii) Name the compound formed when these ions react with each other.

\_\_\_\_\_

(1)

(Total 6 marks)

6.

Read the passage carefully and then answer the questions.

### The electrolysis of acidified water

After a few drops of dilute sulphuric acid have been added to some distilled water, there will be three types of ion in solution:

from the water,  $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}^+(\text{aq}) + \text{OH}^-(\text{aq})$

from the acid,  $\text{H}_2\text{SO}_4(\text{aq}) \rightarrow 2\text{H}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$

When the electrodes (anode and cathode) in a circuit are put into the acidified water, the hydroxide ions and the sulphate ions are both attracted to the electrode called the anode. However, it is harder for the sulphate ions to give up their electrons than for the hydroxide ions to do this. So the hydroxide ions are the ones which react and bubbles of oxygen are formed at the anode.

There are only hydrogen ions to be attracted towards the cathode and, when they get there, they take up electrons to form hydrogen molecules.

*From Chemistry Matters by Richard Hart, reproduced by permission of Oxford University Press*

Even in a small volume of water acidified with dilute sulphuric acid there will be billions of ions. Some will be anions and some will be cations.

- (i) Name the ions in water acidified with dilute sulphuric acid.

\_\_\_\_\_

(1)

- (ii) Explain why only some of the ions are attracted to the anode.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

- (iii) Balance the equation for the reaction of hydroxide ions at the anode.



(1)

(Total 4 marks)

7.

(a) This label has been taken from a packet of *Andrews Antacid*.

**Andrews<sup>®</sup> Antacid**

**FAST EFFECTIVE RELIEF FROM  
3 KINDS OF INDIGESTION**

**HEARTBURN  
ACID INDIGESTION  
TRAPPED WIND**

**DISPERSE IN THE MOUTH**

When your stomach produces more acid than it can cope with, symptoms can strike in different ways. Andrews Antacid tablets neutralise excess acid and give fast and effective relief from all 3 kinds of indigestion - heartburn, acid indigestion and trapped wind.  
*DOSEAGE: Adults - suck or chew 1 to 2 tablets as required.*  
*Not recommended for children.*  
Do not exceed 12 tablets in 24 hours. If symptoms persist consult your doctor. Store below 25°C in a dry place.

Active ingredients:	
Calcium Carbonate	600mg,
Magnesium Carbonate	125mg

 **STERLING HEALTH** GUILDFORD, SURREY  
PL 0071/0321

(i) Write the simplest ionic equation which represents a neutralisation reaction.

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(1)

(ii) Chewing the tablet cures indigestion faster than swallowing the tablet whole. Explain why.

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(1)

- (b) The active ingredients in the *Antacid* react with hydrochloric acid in the stomach to give salts, water and carbon dioxide.

A student investigated how quickly the tablets react with **excess** hydrochloric acid.

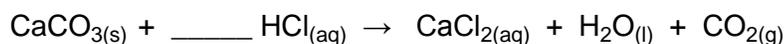
40 cm<sup>3</sup> of dilute hydrochloric acid were placed in a conical flask. The flask was placed on a direct reading balance. Two *Antacid* tablets were quickly added to the flask. The apparatus was weighed immediately. At the same time, a stop clock was started. The mass was recorded every half minute for 5 minutes.

The results are shown in the table below.

Mass of flask + contents (g)	92.0	90.0	89.0	88.3	87.8	87.5	87.3	87.1	87.0	87.0	87.0
Time (minutes)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

The main active ingredient in *Andrews Antacid* is calcium carbonate.

- (i) Balance the equation which represents the reaction between calcium carbonate and hydrochloric acid.



(1)

- (ii) State the meaning of the symbol "(aq)".

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(1)

- (iii) Why does the mass of the flask and contents decrease?

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(1)

- (c) (i) Plot the results on the graph below and draw a smooth curve to show how the mass of the flask and its contents changes with time. Label this curve "A".



**(3)**

- (ii) One of the results does not appear to fit the pattern. Circle this result on the graph.

**(1)**

- (d) The student did a second experiment. The only change was that the acid was twice as concentrated.

On the graph, sketch a second curve to show a possible result for this experiment. Label this curve "B".

**(2)**

**(Total 12 marks)**

8.

Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.

The table gives information about the extraction of some metals.

Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with
Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

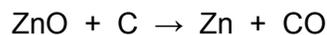
(a) Explain why gold is found mainly as the metal itself in the Earth.

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(1)

(b) One of the reactions involved in producing zinc is represented by this equation.



Explain why carbon can be used to extract zinc.

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(1)

(c) Sodium is one of the most abundant metals on Earth.

Explain, as fully as you can, why sodium was not extracted until 1807.

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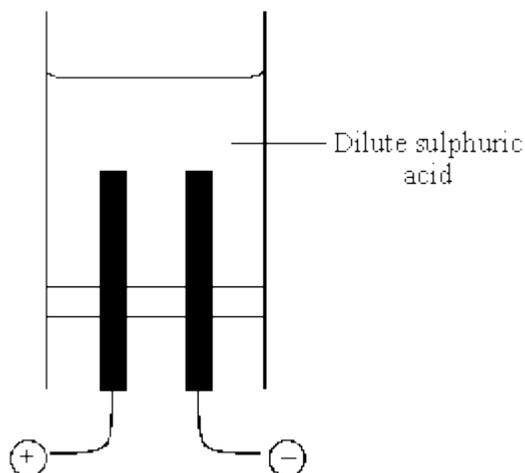
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(2)

(Total 4 marks)

9.

An electric current was passed through dilute sulphuric acid. The apparatus used is shown. Oxygen was formed at the anode.

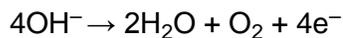


- (a) What name is given to solutions which decompose when electricity is passed through them?

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(1)

- (b) The ionic equation for the reaction at the anode is:



Explain this type of reaction.

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(2)

- (c) Write a **balanced** ionic equation for the reaction at the cathode.

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(2)

- (d) What happens to the concentration of the sulphuric acid as the electricity is passed through it? Explain your answer.

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(3)

(Total 8 marks)