

Name:

Date:

C4 - Test 5
CHEMICAL CHANGES
Advanced

GCSE

CHEMISTRY

AQA - Combined Science

Mark

Grade

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.

A scientist does two tests on four white solids. The solids are labelled **A**, **B**, **C** and **D**.

Test 1 Adds the sample of the solid to distilled water and stirs.

Test 2 Measures the pH of the solution after **Test 1**

Table 1 shows the results.

Table 1

Solid	Appearance after stirring	pH
A	colourless solution, no solid	14
B	colourless solution, no solid	3
C	colourless solution, solid remains	9
D	colourless liquid, solid remains	7

These four solids are:

- magnesium oxide
- phosphorus oxide
- silicon dioxide
- sodium oxide.

Table 2 shows the solubility of these four solids in water.

Table 2

Solid	Solubility in grams per 100 cm³ of water
Magnesium oxide	0.01
Phosphorus oxide	52
Silicon dioxide	0
Sodium oxide	109

(a) Identify the solids **A**, **B**, **C** and **D**.

Explain your answers.

(6)

(b) 10 cm³ of solution **B** is added to a beaker.

Distilled water is added to the beaker until the final volume in the beaker is 1000 cm³

The pH of the solution is measured before and after distilled water is added.

Table 3 shows the results.

Table 3

Volume of solution in beaker	pH of solution B
10 cm ³	3
1000 cm ³	X

Calculate the value of **X**.

X = _____

(2)

(Total 8 marks)

2.

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)

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

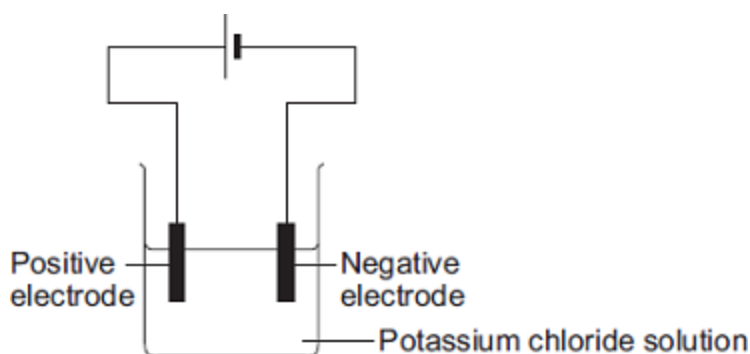
Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

Suggest why.

(1)

(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 on the Chemistry Data Sheet may help you to answer this question.

(3)

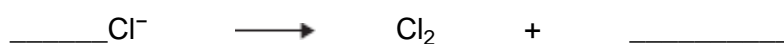
(c) The student tried to electrolyse molten potassium chloride to produce potassium.

(i) Potassium metal was produced at the negative electrode.

Describe how potassium atoms are formed from potassium ions.

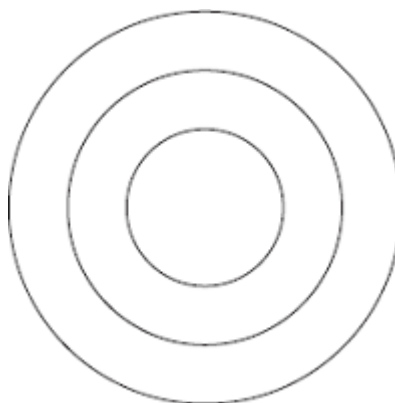
(2)

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



(1)

(iii) Complete the diagram to show the electronic structure of a chloride ion (Cl^-).



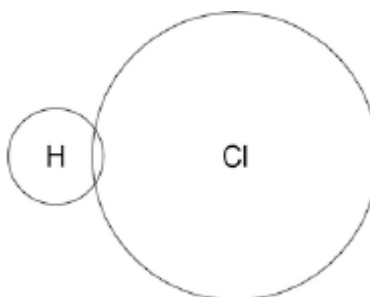
(1)

(Total 10 marks)

3.

Hydrogen chloride (HCl) is a gas.

(a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



(1)

- (b) Hydrochloric acid is a strong acid.
Ethanoic acid is a weak acid.

Describe a reaction that could be used to show the difference between a weak acid and a strong acid.

You should explain why the weak acid and the strong acid give different results.

(6)

(Total 7 marks)

4.

Limestone is used as a building material. Acid rain erodes limestone.

- (a) Limestone contains calcium carbonate.
The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.



Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

(2)

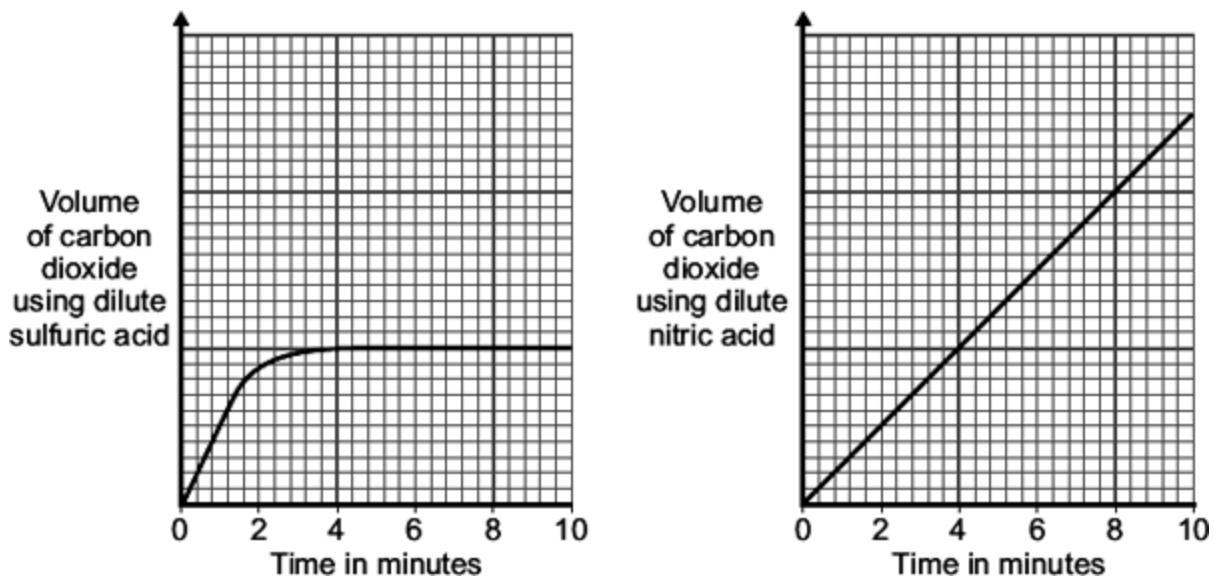
(b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone). The type of acid was changed but all other variables were kept the same.

The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).

The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.

The results are shown below.

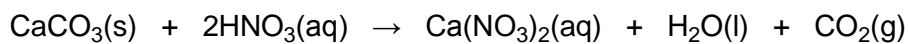


(i) State **two** variables that must be kept the same for this investigation.

(2)

- (i) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.



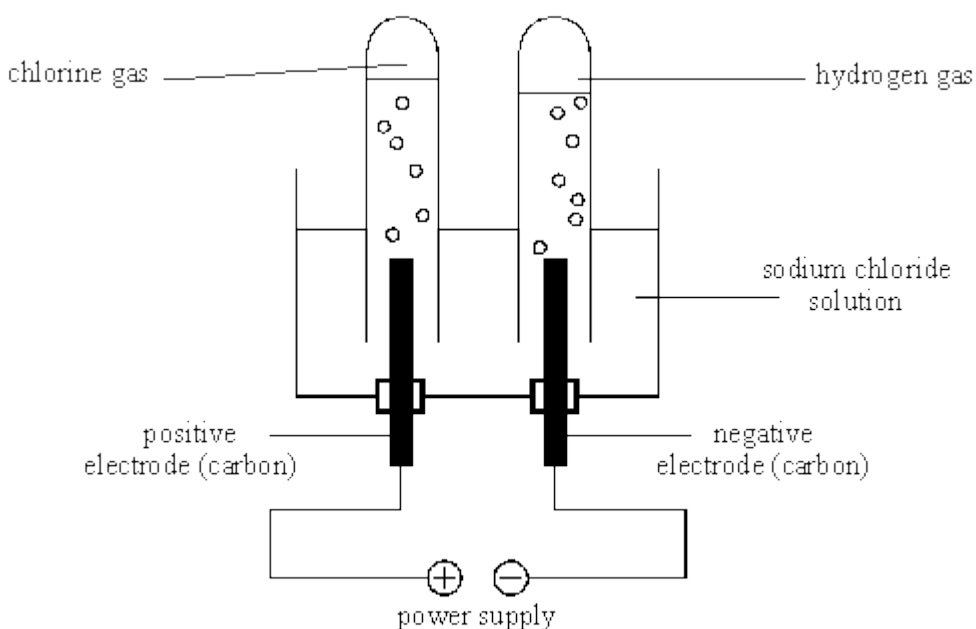
Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

(3)

(Total 7 marks)

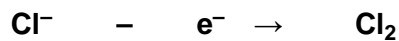
5.

The diagram shows electrolysis of sodium chloride solution.



- (a) Complete and balance these equations to show the reactions during electrolysis.

At the positive electrode

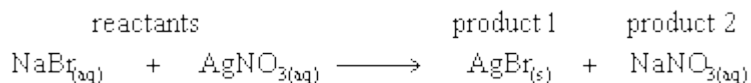


At the negative electrode



(2)

- (b) Silver halides such as silver chloride and silver bromide are used in photography. The equation shows a reaction to prepare a silver halide.



Name and describe the products of this reaction, in words, as fully as you can.

product 1

product 2

(4)

(Total 6 marks)

6.

Aluminium is extracted from aluminium oxide.

- (a) The formula of aluminium oxide is Al_2O_3

The relative formula mass (M_r) of aluminium oxide is 102.

Calculate the percentage of aluminium in aluminium oxide.

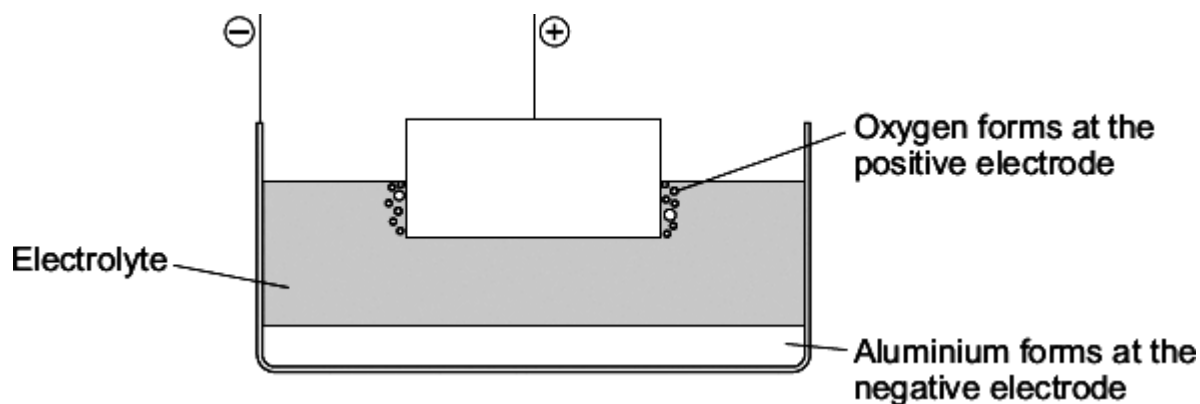
Relative atomic masses (A_r): O = 16; Al = 27.

Percentage of aluminium = _____ %

(2)

(b) Aluminium is extracted from aluminium oxide using electrolysis.

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

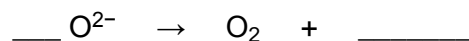


(i) The electrolyte contains cryolite.

Explain why.

(2)

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



(2)

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

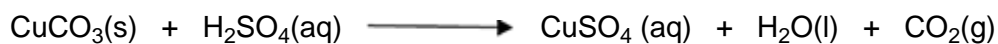
Explain why.

(2)

(Total 8 marks)

7.

The salt copper sulfate can be made by reacting copper carbonate with dilute sulfuric acid.



(a) Write a method that a student could use to prepare a pure, dry sample of copper

You do **not** need to write a risk assessment or include safety points.

(6)

(b) Calculate the **number of molecules** in 14 g of carbon dioxide.

Give your answer in standard form.

Relative atomic masses (A_r): C = 14; O = 16

Answer = _____ molecules

(4)

(Total 10 marks)