

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A322/02

Unit 2: Modules C4 C5 C6 (Higher Tier)

Candidates answer on the question paper.
A calculator may be used for this paper.

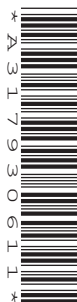
OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

**Tuesday 28 June 2011
Morning**

Duration: 40 minutes



Candidate forename		Candidate surname	
Centre number		Candidate number	

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

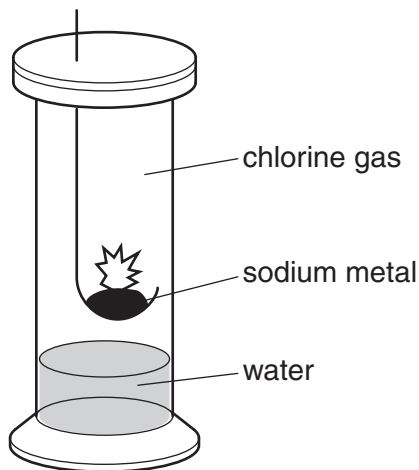
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- This document consists of **16** pages. Any blank pages are indicated.
- The Periodic Table is printed on the back page.

2

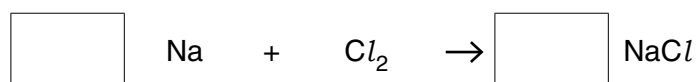
Answer **all** the questions.

- 1 Hot sodium metal reacts with chlorine gas to make sodium chloride.

Eve does this reaction in a gas jar that contains a small amount of water.



- (a) Balance the equation by filling in the boxes.



[1]

- (b) During the reaction, chlorine **atoms** become chloride **ions**.

Which statements about the reaction are **true** and which are **false**?

Put a tick (✓) in one box in each row.

	true	false
Each chlorine atom gains seven electrons.		
Each chloride ion has a positive charge.		
Chloride ions have more electrons than chlorine atoms.		
Chloride ions join together to form Cl_2 molecules.		
Chlorine atoms gain electrons from sodium atoms.		

[2]

3

(c) Sodium chloride dissolves in water.

What happens as sodium chloride dissolves?

Put a tick (✓) in the correct box in each row to complete the sentence.

	... increases.	... decreases.	... stays the same.
The movement of the ions ...			
The charge on each ion ...			
The total number of ions ...			
The distance between the ions ...			
The electrical conductivity of the water ...			

[3]

(d) Eve investigates the reaction of sodium with another halogen.

She compares the reaction of **bromine** gas with sodium to the reaction of chlorine gas with sodium.

Which of the following statements about the reaction between bromine gas and sodium are true?

Put ticks (✓) in the boxes next to the **two** correct answers.

The colour of the halogen is different.

☐

The rate of the reaction is different.

☐

The same compound is made at the end of the reaction.

☐

The product of the reaction is purple.

☐

[1]

[Total: 7]

4

- 2 (a) Lithium (atomic number 3) and potassium (atomic number 19) are Group 1 elements.

Compare the **atomic structures** of a lithium atom and a potassium atom.

How are they different and how are they similar?

.....

.....

.....

.....

.....

..... [4]

- (b) Jim tests two white solids.

One is a lithium compound, the other is a potassium compound.

Which two statements, when taken together, describe how to tell the two compounds apart?

Put a tick (✓) in the boxes next to the **two** correct statements.

Dissolve the compounds in water.

☐

Heat the compounds in a hot flame.

☐

Look at the spectrum given off by each compound.

☐

Electrolyse solutions of the compounds.

☐

Find out which compound is flammable.

☐

[2]

[Total: 6]

5

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Question 3 starts on page 6

PLEASE DO NOT WRITE ON THIS PAGE

- 3 The compounds in the table can be used to improve soil for growing crops.

compound name	formula
sodium phosphate	Na_3PO_4
sodium nitrate	NaNO_3
calcium hydroxide	$\text{Ca}(\text{OH})_2$
.....	K_2SO_4
potassium phosphate	K_3PO_4
calcium sulfate	CaSO_4

- (a) Complete the table by filling in the **name** of the compound with the formula K_2SO_4 . [1]
- (b) Sometimes compounds are mixed to give a fertiliser that supplies **nitrogen**, **phosphorus** and **potassium** to the soil.



Which two compounds could be used **together** to make a fertiliser that contains all three elements?

Put rings around the **two** correct answers.

Na_3PO_4 NaNO_3 CaSO_4 $\text{Ca}(\text{OH})_2$ K_2SO_4 K_3PO_4 [1]

- (c) Acidic compounds in the soil produce ions that make the soil water acidic.

- (i) Which ion is produced by all acids when they dissolve in water?

Put a ring around the correct answer.

Cl^- H^+ OH^- Na^+ SO_4^{2-} [1]

7

- (ii) One of the compounds given in the table is added to soil to neutralise acids. This compound dissolves in water to form an alkaline solution. Which compound dissolves to form an alkaline solution?

Put a (ring) around the correct answer.

Na_3PO_4 NaNO_3 $\text{Ca}(\text{OH})_2$ K_2SO_4 K_3PO_4 [1]

- (d) (i) The formula of potassium phosphate is K_3PO_4 . The symbol for a potassium ion is K^+ .

What is the formula of a phosphate ion?

Put a (ring) around the correct answer.

PO_4^+ PO_4^- PO_4^{2+} PO_4^{2-} PO_4^{3+} PO_4^{3-} PO_4^{4+} PO_4^{4-} [1]

- (ii) The formula of a nitrate ion is NO_3^- .

What is the formula of potassium nitrate?

answer [1]

- (e) Potassium phosphate can be made by reacting phosphoric acid with a potassium compound. Which potassium compounds react with phosphoric acid to make potassium phosphate?

Put ticks (✓) in the boxes next to the **two** correct answers.

potassium carbonate

☐

potassium chloride

☐

potassium hydroxide

☐

potassium nitrate

☐

potassium sulfate

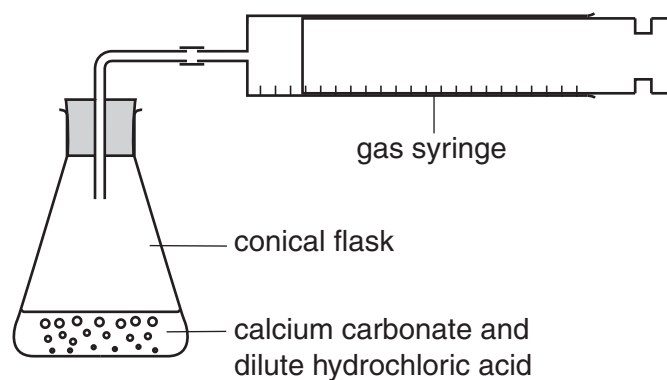
☐

[2]

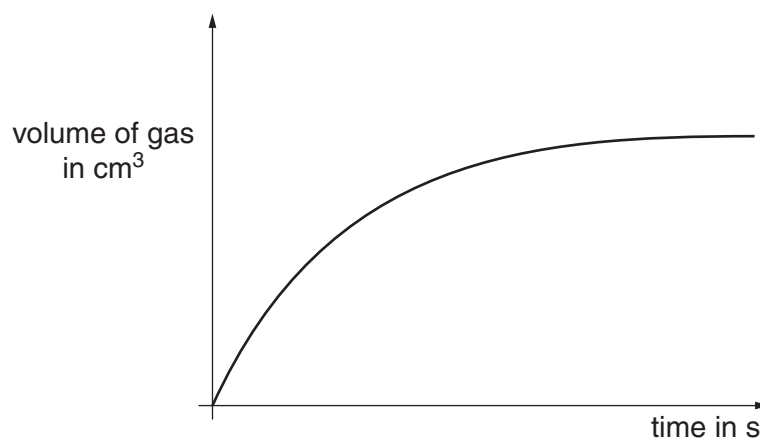
[Total: 8]

8

- 4 Jake carries out an experiment to investigate the rate of reaction between calcium carbonate and dilute hydrochloric acid.



This is a graph of Jake's results.



- (a) Describe what happens to the rate of the reaction during the experiment.

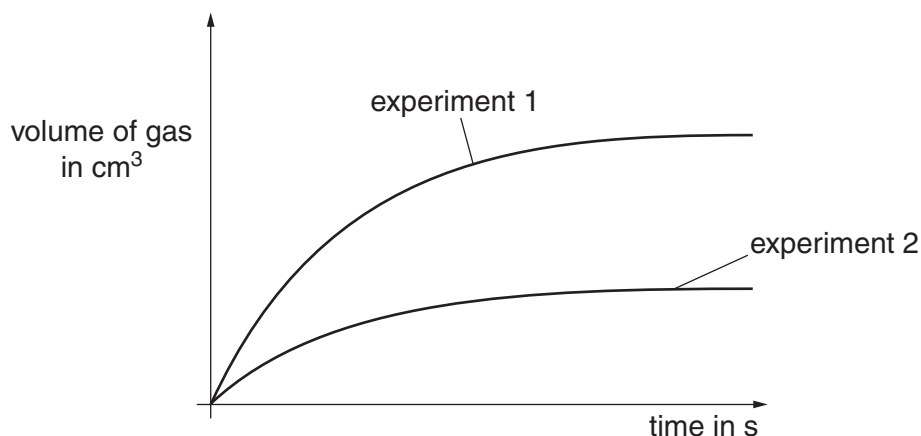
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.....

..... [2]

9

- (b) Jake does a second experiment.
Jake plots the results of his second experiment.



These are the conditions that Jake used for his first experiment.

conditions for experiment 1

acid volume: 25 cm³

acid concentration: 10 g/dm³

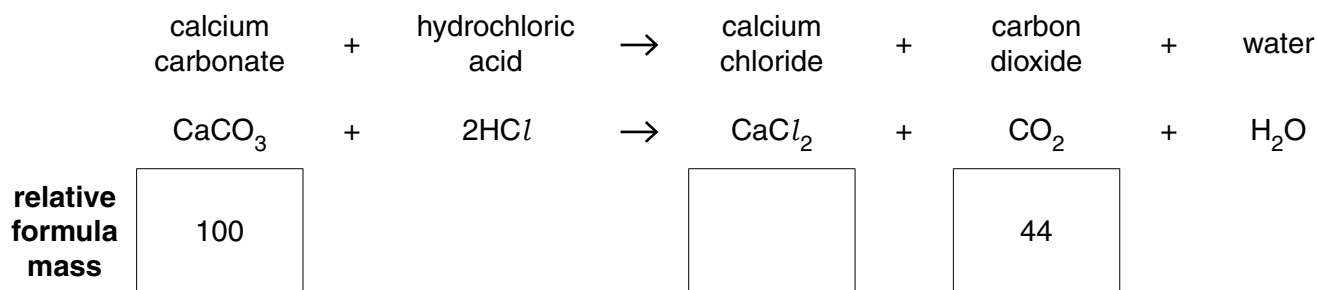
calcium carbonate: 5.0 g, large pieces

Jake used the same mass of calcium carbonate in his second experiment.

Suggest and explain one change that Jake makes to the conditions for **experiment 2**.

.....
.....
..... [2]

- (c) Jake writes an equation for the reaction between calcium carbonate and dilute hydrochloric acid. He calculates the relative formula masses of some of the compounds.



- (i) Fill in the empty box to show the relative formula mass of calcium chloride. Use the Periodic Table to find the relative atomic masses you need. [1]
- (ii) Jake used 5.0 g of calcium carbonate in his experiment. What is the maximum mass of carbon dioxide that can be made from 5.0 g of calcium carbonate?

Put a tick (✓) in the box next to the correct answer.

1.1 g ☐

2.2 g ☐

4.4 g ☐

5.0 g ☐

5.6 g ☐

[1]

- (iii) Jake collects much less carbon dioxide than he expects from 5.0 g of calcium carbonate. Which statement gives the best explanation for this?

Put a tick (✓) in the box next to the correct answer.

The acid is used up before all the calcium carbonate reacts. ☐

Jake weighs out more than 5.0 g calcium carbonate. ☐

Some of the carbon dioxide is used up in the reaction. ☐

The reaction rate varies in each experiment. ☐

Jake does not control the temperature. ☐

[1]

[Total: 7]

- 5 The tables give information about the elements in the air and in the Earth's crust.

elements in the air		elements in the Earth's crust	
element	percentage	elements	percentage
nitrogen	78%	silicon	47%
oxygen	21%	oxygen	28%
other gases (including carbon dioxide)	1%	aluminium	8%
		all other elements	17%

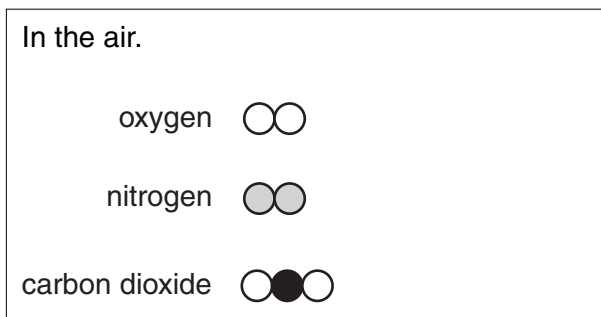
- (a) Which of the following elements are found **only in air**, **only in the Earth's crust** or **in both**?

Put ticks (✓) in the correct boxes.

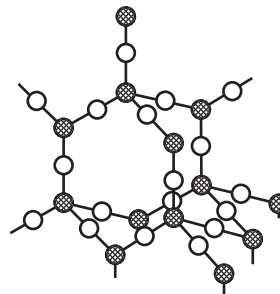
	only in air	only in the Earth's crust	in both
metal elements			
non-metal elements			

[1]

- (b) The boxes show how the atoms are arranged in some of the chemicals in the air and in the Earth's crust.



In the Earth's crust silicon and oxygen are mainly found as silicon dioxide.



- (i) Draw straight lines from **oxygen** to show its **type of bonding** and its **structure**.

type of bonding

ionic

covalent

metallic

oxygen

structure

atoms held together in a lattice

small molecules

ions with opposite charges attracted to each other

[1]

- (ii) Draw straight lines from **silicon dioxide** to show its **type of bonding** and its **structure**.

type of bonding

ionic

covalent

metallic

silicon dioxide

structure

atoms held together in a lattice

small molecules

ions with opposite charges attracted to each other

[1]

13

(iii) Complete the sentences about the properties of silicon dioxide.

Put a ring around the correct word in each line.

Silicon dioxide has a **high** / **low** melting point.

Silicon dioxide is very **hard** / **soft**.

Silicon dioxide is a **good** / **poor** electrical conductor.

Silicon dioxide **dissolves** / **does not dissolve** in water.

[2]

(c) The information given in this question contains examples of both elements and compounds. Explain the difference between elements and compounds. Give examples in your answer.

.....

.....

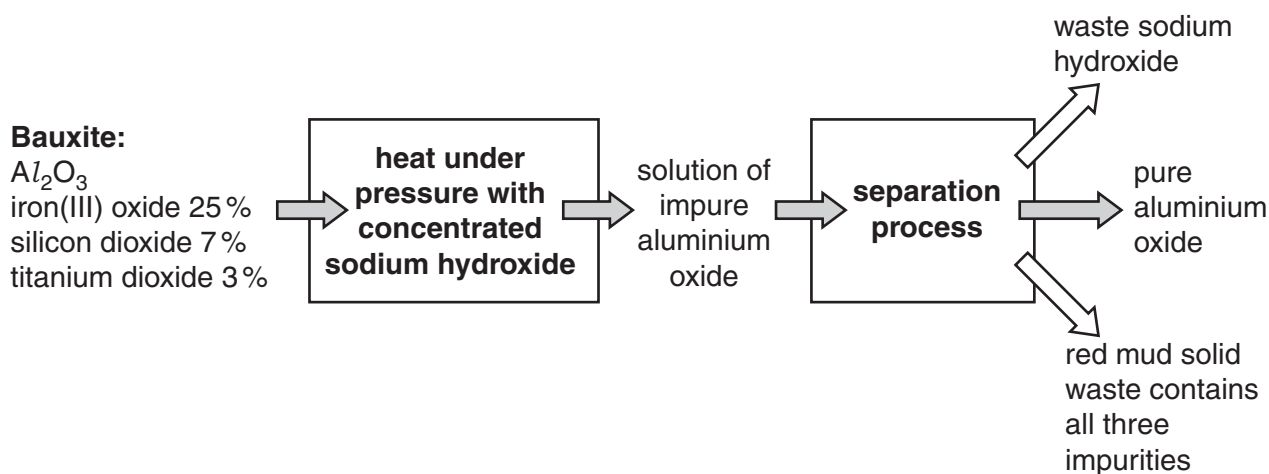
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..... [3]

[Total: 8]

- 6 Aluminium is extracted from bauxite by electrolysis. Bauxite contains aluminium oxide, Al_2O_3 , with some impurities. The first stage in the process is to purify the bauxite. The flow chart shows how this is done.



- (a) (i) Which of the following statements about the process are **true** and which are **false**?

Put a tick (✓) in the correct box in each row to show whether it is **true** or **false**.

	true	false
Bauxite contains over 60 % aluminium oxide.		
Aluminium oxide is not soluble in sodium hydroxide.		
The impurities dissolve because sodium hydroxide is acidic.		
The process does not need any energy input.		

[2]

- (ii) The purification process produces waste products.

Suggest how the waste products from the process could affect the environment.

.....

..... [1]

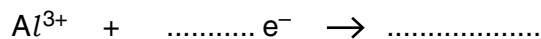
15

(b) Aluminium is extracted from purified aluminium oxide by electrolysis.

Oxygen gas is also made.

Complete the equations to show the changes that take place at each electrode during the electrolysis.

At the negative electrode.



At the positive electrode.



[3]

[Total: 6]

END OF QUESTION PAPER

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*The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.