OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

A322/02

Unit 2: Modules C4 C5 C6 (Higher Tier)

11LMP06141

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

A322202

Candidate forename		Candidate surname	

Centre number						Candidate number				

MODIFIED LANGUAGE

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.

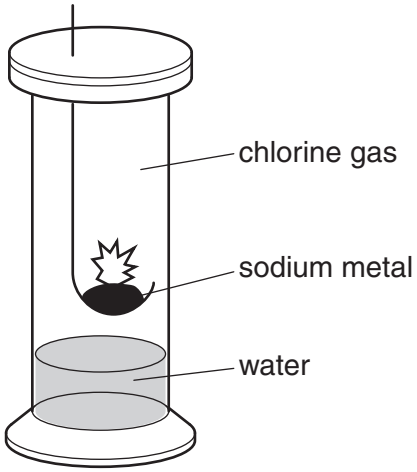
INFORMATION FOR CANDIDATES

- 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.

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.

$$\square\ Na + Cl_2 \rightarrow \square\ NaCl$$

[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]

(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]

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]

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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	$Ca(OH)_2$
....	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 **$NaNO_3$** **$CaSO_4$** **$Ca(OH)_2$** **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]**

(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 **$NaNO_3$** **$Ca(OH)_2$** **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 ☐

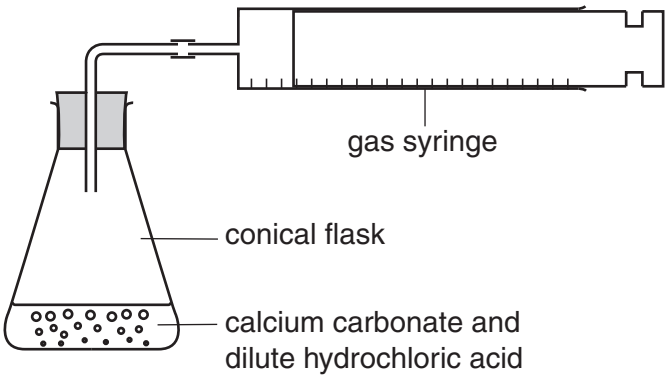
potassium nitrate ☐

potassium sulfate ☐

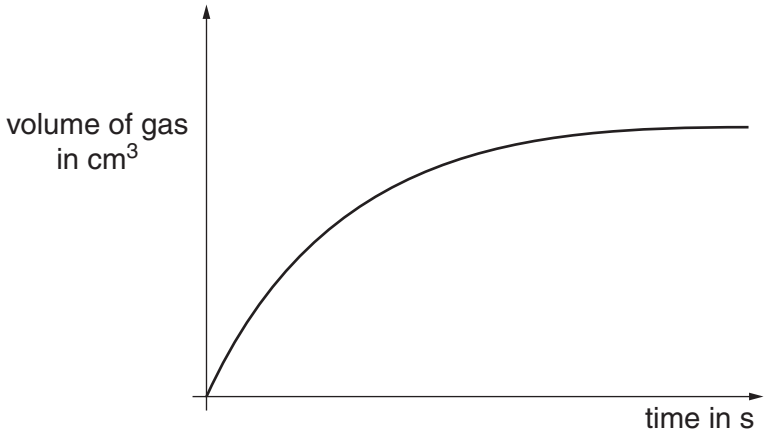
[2]

[Total: 8]

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.



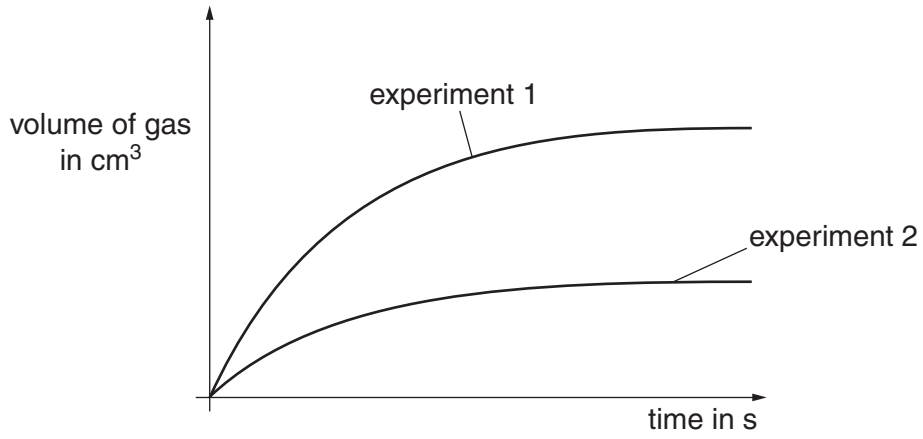
(a) Describe what happens to the rate of the reaction during the experiment.

.....

.....

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

(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 cm^3
acid concentration: 10 g / dm^3
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.

	calcium carbonate	+	hydrochloric acid	→	calcium chloride	+	carbon dioxide	+	water
	$CaCO_3$	+	$2HCl$	→	$CaCl_2$	+	CO_2	+	H_2O
relative formula mass	100						44		

(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 is different 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	
element	**percentage**
nitrogen	78%
oxygen	21%
other gases (including carbon dioxide)	1%

elements in the Earth's crust	
elements	**percentage**
silicon	47%
oxygen	28%
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.

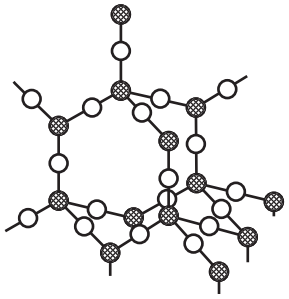
In the air.

oxygen 

nitrogen 

carbon dioxide 

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		**structure**
ionic		atoms held together in a lattice
covalent	**oxygen**	small molecules
metallic		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		**structure**
ionic		atoms held together in a lattice
covalent	**silicon dioxide**	small molecules
metallic		ions with opposite charges attracted to each other

[1]

(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.

.....

.....

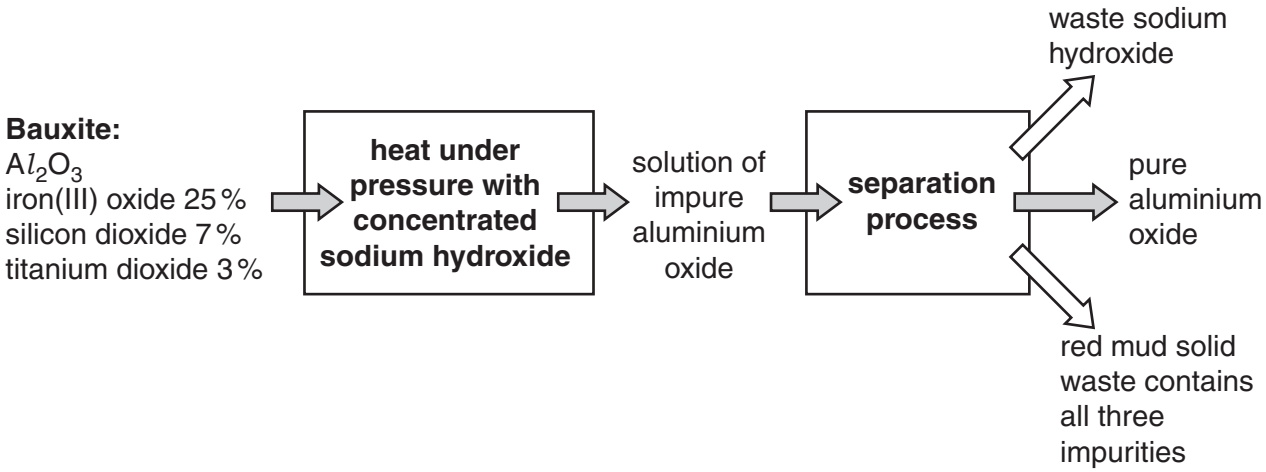
.....

.....

..... **[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]**

(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.

$$Al^{3+} + \text{.....} e^- \rightarrow \text{.....}$$

At the positive electrode.

$$2O^{2-} \rightarrow \text{.....} + \text{.....} e^-$$

[3]

[Total: 6]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.