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)

CUP/T71051

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)

Friday 23 January 2009
Morning

Duration: 40 minutes

A322202

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

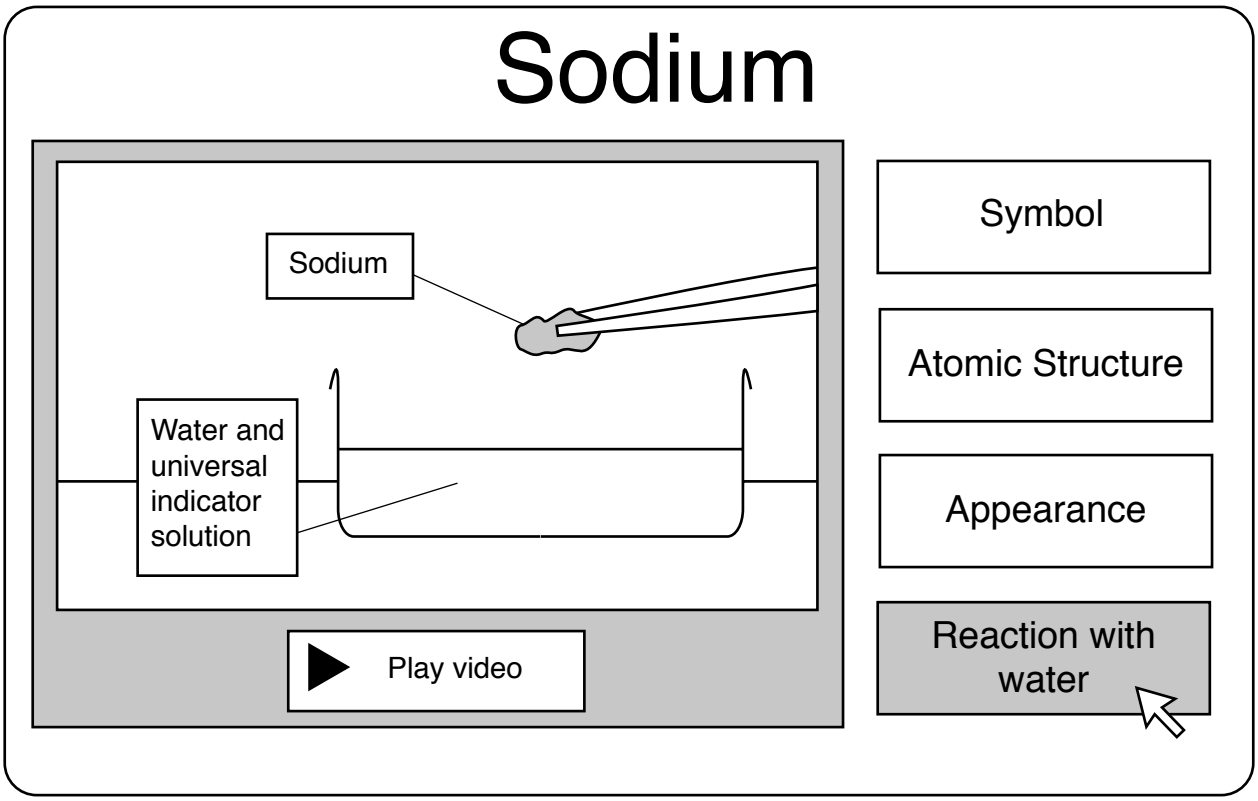
INFORMATION FOR CANDIDATES

- 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**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	9	
2	5	
3	5	
4	3	
5	6	
6	9	
7	5	
TOTAL	42	

Answer **all** the questions.

1 Eve looks at a website about sodium.
She clicks on the reaction with water.



(a) When sodium is dropped into water, a chemical reaction happens.

- Complete the word equation.
- Complete and balance the symbol equation for the reaction.

sodium + water → sodium hydroxide + ...

..... + $2H_2O$ → ..... + ...

[3]

(b) Eve clicks on the button to find out the appearance of sodium.

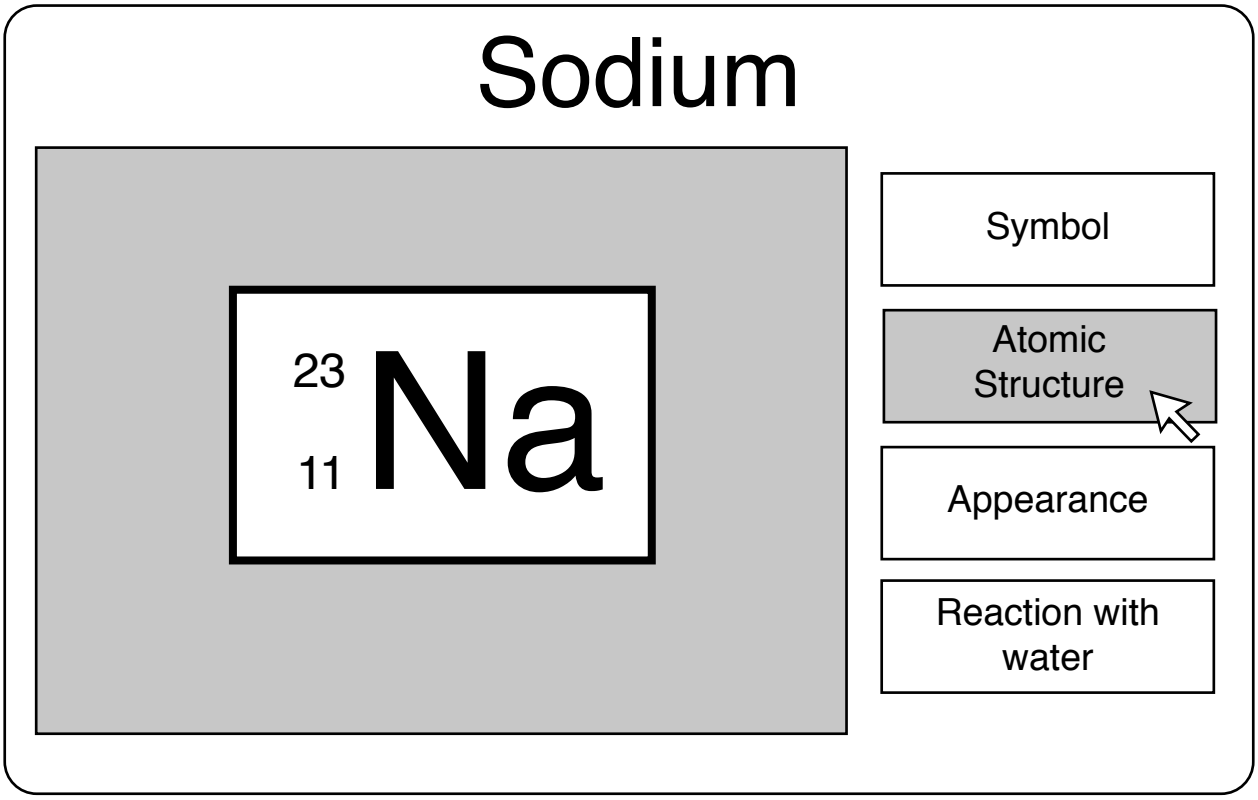
Which statements about the appearance of sodium are correct?

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

When sodium is cut it is very shiny.	☐
Sodium looks like white crystals.	☐
Sodium goes dull quickly in the air.	☐
Sodium is a liquid at room temperature.	☐
Sodium gives off a yellow vapour.	☐

[2]

(c) Eve clicks on the button to find out about the atomic structure of sodium.
The website shows the following information about sodium.



Which of the following statements about the atomic structure of sodium are true and which are false?

Put ticks (✓) in the correct boxes.

a sodium atom has …	**true**	**false**
… 23 protons		
… 12 neutrons		
… 12 electrons		
… one electron in the outer shell		
… 3 electron shells		

[2]

(d) Eve looks at other elements on the website.

Join the boxes to connect each **element** with its correct **statement**.

potassium	is in the same group but is less reactive than sodium
lithium	has the symbol K
calcium	reacts with sodium to make salt
chlorine	is a metal and is in a different group to sodium

[2]

[Total: 9]

2 Joe is doing some experiments on a compound called calcium chloride.

(a) Joe wants to prove that the compound contains calcium.

He tests the compound by heating a crystal in a Bunsen flame.

What should Joe look for when he heats the compound?

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

look to see if it fizzes	☐
look to see if it melts	☐
look to see if it burns	☐
look for a particular colour in the flame	☐
measure the temperature change	☐

[1]

(b) This is the label from the jar of calcium chloride.

Calcium chloride

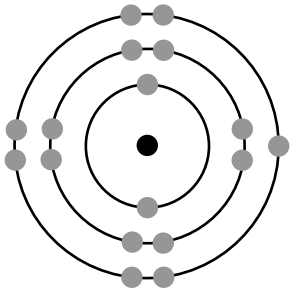
$CaCl_2$

The symbol for a chloride ion is Cl^-.

What is the symbol for a calcium ion?

answer ..... **[1]**

(c) This diagram shows the structure of a chlorine atom.



chlorine atom

How many electrons are in the outer shell of a chloride **ion**?

answer ..... **[1]**

(d) Joe dissolves the calcium chloride in water to make a solution.
He passes electricity through the calcium chloride solution.
Which two statements **when put together** explain why the solution conducts electricity?

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

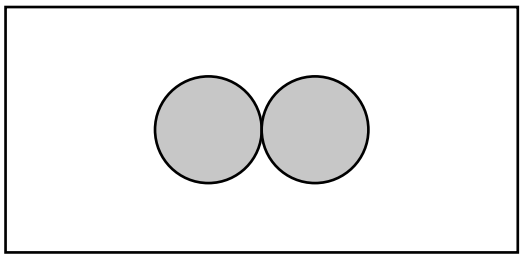
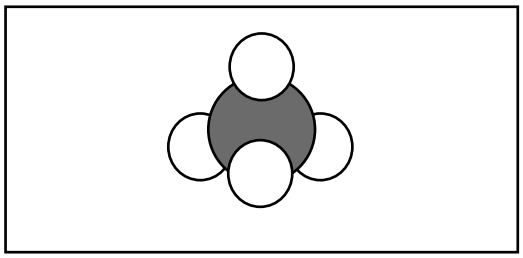
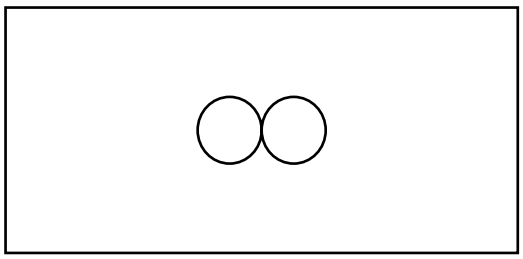
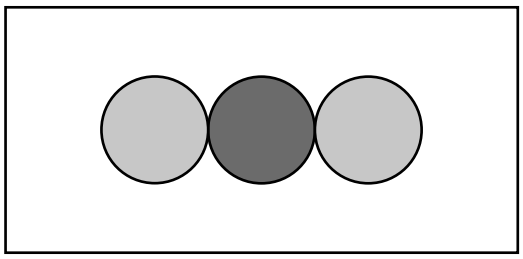
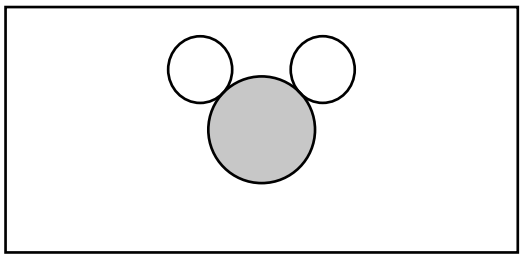
calcium chloride solution contains ions	☐
calcium is a metal	☐
chlorine is a non-metal	☐
chlorine is in Group 7	☐
the particles in the solution are free to move	☐
the solution contains water molecules	☐

[2]

[Total: 5]

3 The diagrams show the structures of some of the molecules in air.

(a) Draw straight lines to join each **gas** to the correct **structure**.

methane CH_4	
carbon dioxide CO_2	
oxygen O_2	
water H_2O	
	

[3]

(b) The Earth's crust contains many different elements.

(i) Which of these elements is the **most abundant** in the Earth's crust?

Put a (ring) around the correct answer.

argon **carbon** **iron** **nitrogen** **oxygen**

[1]

(ii) Which of these elements is **not** found in gases in the Earth's atmosphere?

Put a (ring) around the correct answer.

argon **carbon** **iron** **nitrogen** **oxygen**

[1]

[Total: 5]

4 The table shows some data about oxygen and some other chemicals **A**, **B**, **C** and **D**.

Chemical	Melting point in °C	Boiling point in °C
Oxygen	–218	–183
A	–7	59
B	–210	–196
C	–157	–152
D	1074	1740

Use the letters **A**, **B**, **C** and **D** to answer the following questions.

(a) Which chemical has a lower boiling point than oxygen?

answer ..... **[1]**

(b) Which chemical is a liquid at room temperature (20 °C)?

answer ..... **[1]**

(c) One chemical has ionic bonding. Which one?

answer ..... **[1]**

[Total: 3]

5 Metals can be extracted from their oxides in different ways.

(a) Copper metal can be extracted from copper oxide by heating with carbon.
What type of chemical reaction happens to the copper oxide during the extraction?

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

combustion	☐
neutralisation	☐
oxidation	☐
reduction	☐

[1]

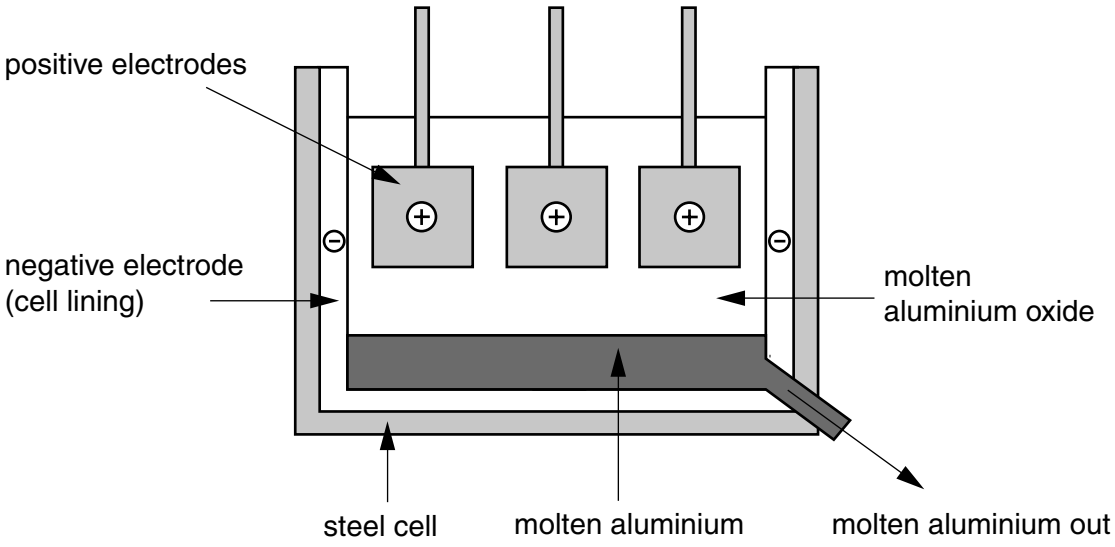
(b) Aluminium **cannot** be extracted from aluminium oxide by reaction with carbon.
Which of the following is the best reason why.

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

Aluminium does not react with oxygen.	☐
Aluminium is too reactive.	☐
Aluminium oxide has a very high melting point.	☐
Aluminium is in Group 3.	☐

[1]

(c) Aluminium can be extracted by electrolysis, as shown in the diagram.



Complete the equation to show what happens to aluminium ions at the negative electrode.

Al^{3+} + [ ] → [ ]

[2]

(d) Some people think that electrolysing aluminium oxide is very harmful to the environment.

Which of the following statements could be used to argue that the extraction of aluminium **harms** the environment?

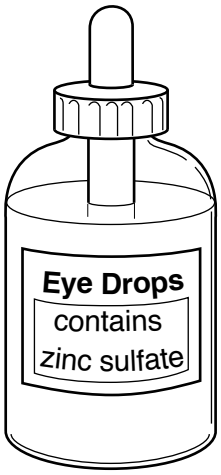
Put ticks (✓) in the boxes next to the **two** best answers.

Large amounts of ore need to be mined for the process.	☐
Aluminium extraction uses large amounts of electricity.	☐
The process operates for 24 hours a day.	☐
Used aluminium articles can be recycled instead of making more aluminium.	☐
If people changed their habits we could use less aluminium.	☐

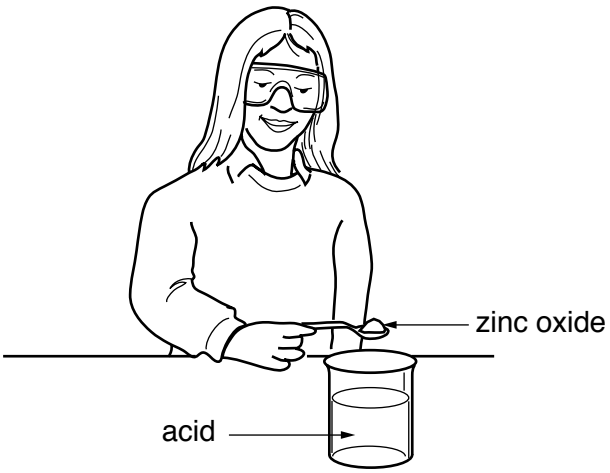
[2]

[Total: 6]

6 Zinc sulfate is a salt used in eye drops.



(a) Liz makes some zinc sulfate by adding zinc oxide to an acid.



Complete the equation by filling in the **name** and **formula** of the acid Liz uses.

zinc oxide + ____ → zinc sulfate + water

ZnO + ____ → $ZnSO_4$ + H_2O

[2]

(b) (i) Liz tests the pH of the acid before she adds the zinc oxide.
Which of the following would **not** show the pH of the acid?

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

Universal Indicator paper	☐
pH probe	☐
Universal Indicator solution	☐
litmus paper	☐

[1]

(ii) How does the pH of the solution change as the acid is used up?
Choose from **A**, **B**, **C**, **D** or **E**.

A	The pH starts at 7 and rises
B	The pH starts at 10 and falls
C	The pH starts at 1 and rises
D	The pH starts at 7 and falls
E	The pH starts at 1 and stays the same

answer ..... **[1]**

(c) Liz works out how much zinc sulfate she can make from different amounts of zinc oxide.
Each of these is a theoretical yield.
The table shows the figures she uses.

	zinc oxide ZnO	**zinc sulfate $ZnSO_4$**
relative formula mass	81	161
Experiment 1	Mass of ZnO used = 16.2 g	Theoretical yield of $ZnSO_4$ = 32.2 g
Experiment 2	Mass of ZnO used = 4.05 g	Theoretical yield of $ZnSO_4$ = ... g

(i) Fill in the table to show the theoretical yield of zinc sulfate in experiment 2.

Choose from this list.

4.05 g **8.05 g** **8.2 g** **16.2 g**

[1]

(ii) How much zinc oxide would Liz need to use to give a theoretical yield of 483 g of zinc sulfate?

Put a (ring) round the correct answer.

3 g **162 g** **243 g** **324 g** **483 g**

[1]

(d) Liz weighs the zinc sulfate that she makes in each experiment.
She uses her theoretical yield to calculate a percentage yield.

The calculation gives a value over 100%. Liz knows this must be wrong.

What errors might Liz have made?

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

Liz forgot to dry her product. ☐

Liz lost some of her product during the experiment. ☐

Liz used less zinc oxide than she meant to. ☐

Liz used more zinc oxide than she meant to. ☐

Liz did not add enough acid. ☐ **[2]**

(e) Liz knows that the zinc sulfate that she has made cannot be used for making eye drops.

Why is her zinc sulfate not suitable?

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

She should have carried out a titration. ☐

The product has not been purified. ☐

She did not check the pH of the zinc oxide. ☐

She has not controlled the rate of reaction. ☐ **[1]**

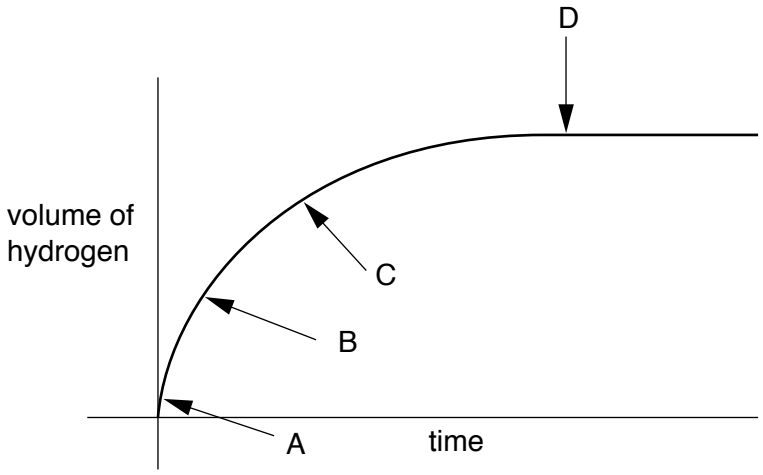
[Total: 9]

7 Rose carries out an experiment to find out the rate of reaction when a small amount of magnesium reacts with hydrochloric acid.

This is the equation for the reaction.

magnesium	+	hydrochloric acid	→	magnesium chloride	+	hydrogen
Mg	+	2HC*l*	→	$MgCl_2$	+	H_2

(a) Rose measures the volume of hydrogen gas that is made.
She takes a reading every 5 seconds.
This graph shows her results.



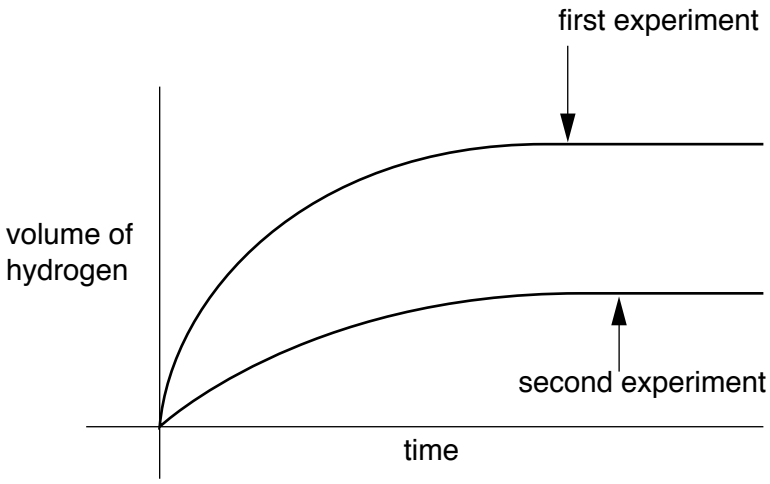
(i) At which point on the graph, **A**, **B**, **C** or **D**, is the reaction happening fastest?

answer ..... **[1]**

(ii) At which point on the graph, **A**, **B**, **C** or **D**, is the acid at its least concentrated?

answer ..... **[1]**

(b) Rose knows that the reaction finishes when the magnesium is all used up.
She does a second experiment. This graph shows the results for both experiments.



What does Rose change when she carries out her second experiment?

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

She uses half the volume of acid that is twice as concentrated. ☐

She uses twice the volume of acid that is half as concentrated. ☐

She uses half as much magnesium. ☐

She uses twice as much magnesium. ☐ **[1]**

(c) Rose carries out a third experiment.
She uses the same conditions as in her first experiment, but she carries out this experiment at a higher temperature.

Which of the following statements are true?

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

More hydrogen is made. ☐

The curve on the graph is steeper at the beginning. ☐

The graph levels out sooner. ☐

The graph finishes at a higher level. ☐

There is an increase in the surface area of the magnesium. ☐ **[2]**

[Total: 5]

END OF QUESTION PAPER

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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

20

**** 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.