Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A322/02

TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

Unit 2: Modules C4 C5 C6 (Higher Tier)

WEDNESDAY 27 JANUARY 2010: Afternoon
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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)

READ INSTRUCTIONS OVERLEAF

DC (SM/SW) MEP10224 24317/2

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.
- 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.
- 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.
- A copy of the Periodic Table is provided.

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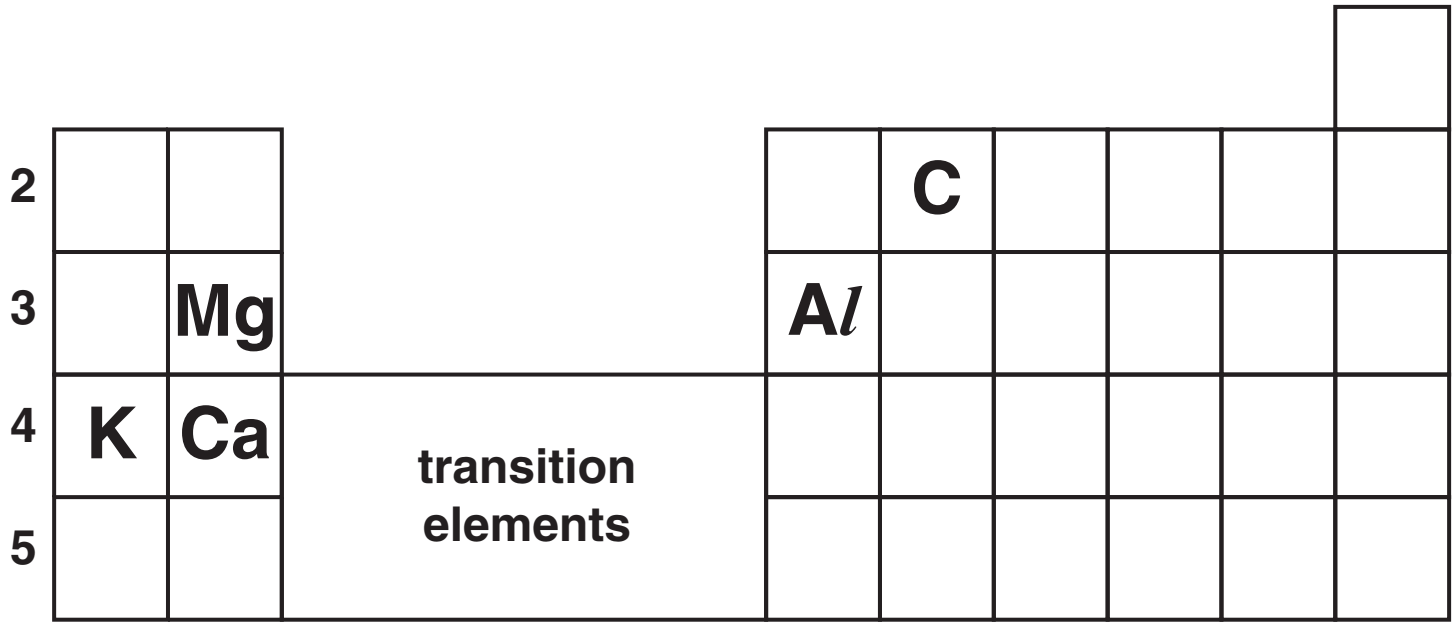
Answer ALL the questions.

1 The diagram shows the position of some elements in the Periodic Table.



Which statements about these elements are TRUE and which are FALSE?

Put a tick (✓) in the correct box for each statement.

	TRUE	FALSE
Magnesium and calcium are in the same period.	☐	☐
All of the elements are metals.	☐	☐
Two of the elements have two electrons in their outer shell.	☐	☐
One of the elements has the electronic configuration 2.8.2.	☐	☐
Carbon has the highest atomic number of these elements.	☐	☐

[2]

[Total: 2]

2 Liz makes some notes about the properties of some elements in Group 1, as shown on page 7 opposite.

(a) Explain how Liz could use her notes to predict the properties of potassium.

_____

_____

_____ **[2]**

(b) Describe <u>TWO</u> patterns in the properties of Group 1 elements shown by the information.

_____

_____

_____ **[2]**

Group 1
lithium Li
sodium Na
potassium K
rubidium Rb

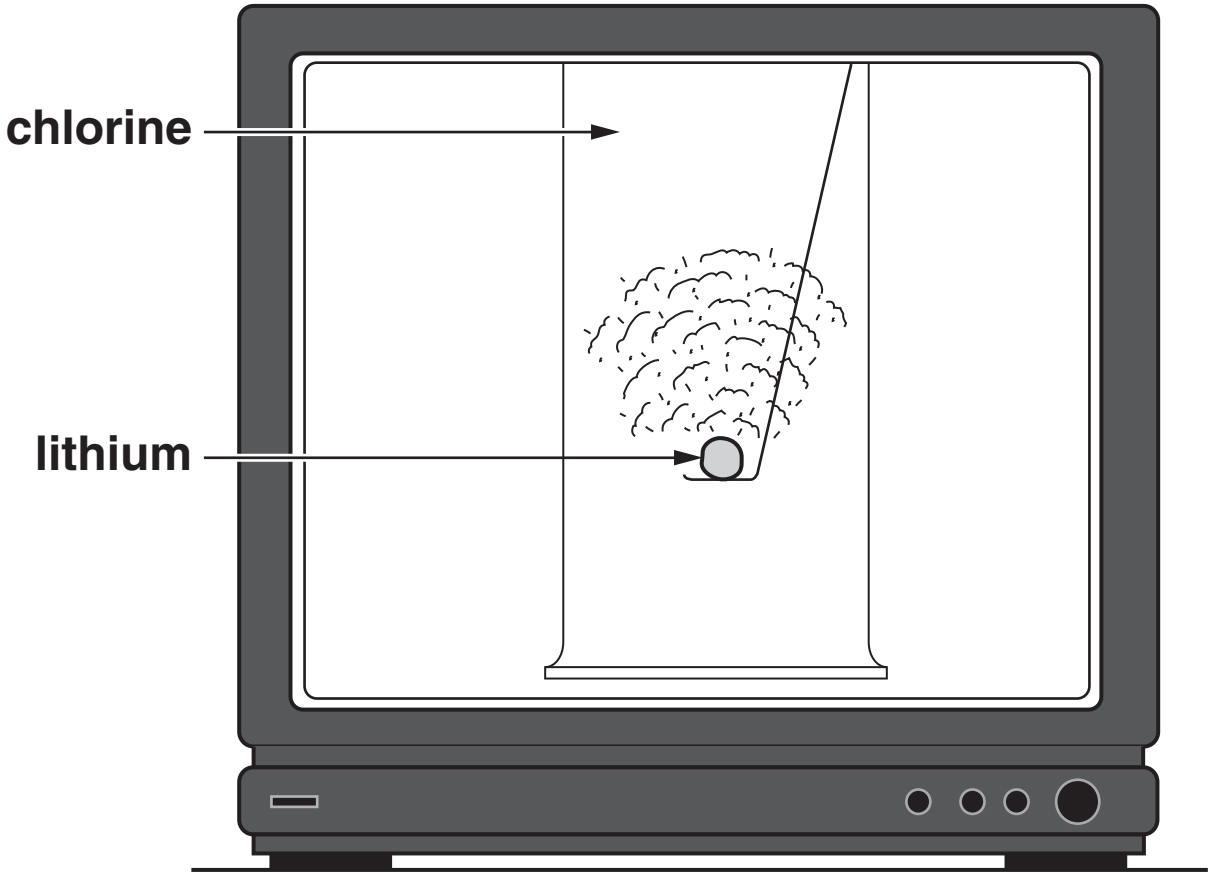
Lithium
Atomic number: 3
Melting point: 181°C
Density: 0.53 g/cm^3

Sodium
Atomic number: 11
Melting point: 98°C
Density: 0.97 g/cm^3

Rubidium
Atomic number: 37
Melting point: 39°C
Density: 1.53 g/cm^3

7

(c) Liz watches a video about the reaction between lithium and chlorine.



(i) What is the name of the product that forms during the reaction?

answer _____ [1]

(ii) Complete and balance the symbol equation for the reaction.

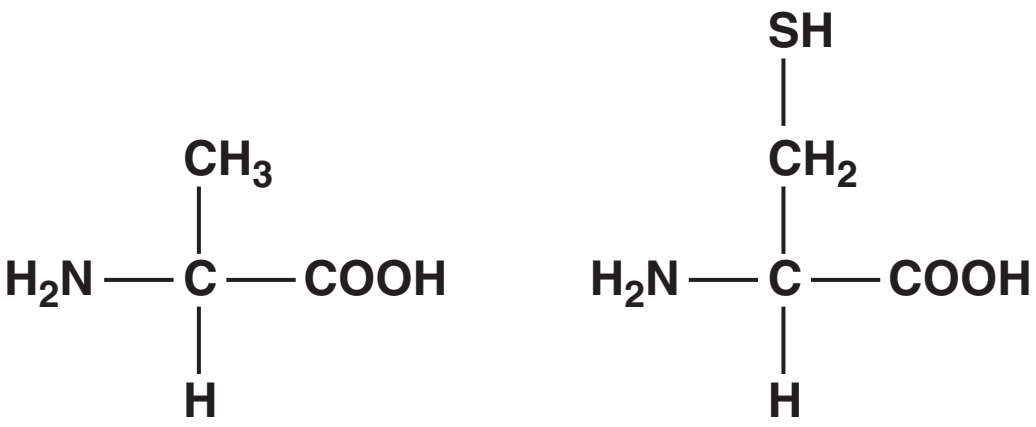
Li + ⟶

[1]

[Total: 6]

3 **Proteins in the human body are formed from amino acids.**

The diagram shows the structures of two amino acids in the human body.



AMINO ACID A **AMINO ACID B**

(a) Complete the formula for amino acid B.

C_3 _____

[2]

(b) The table shows the percentage by mass of each element in amino acid A.

	PERCENTAGE (%) BY MASS
carbon	40
oxygen	36
nitrogen	16
hydrogen	8

Why is the percentage by mass of hydrogen lower than the other elements?

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

There are very few atoms of hydrogen in each molecule. ☐

The molecules are very small. ☐

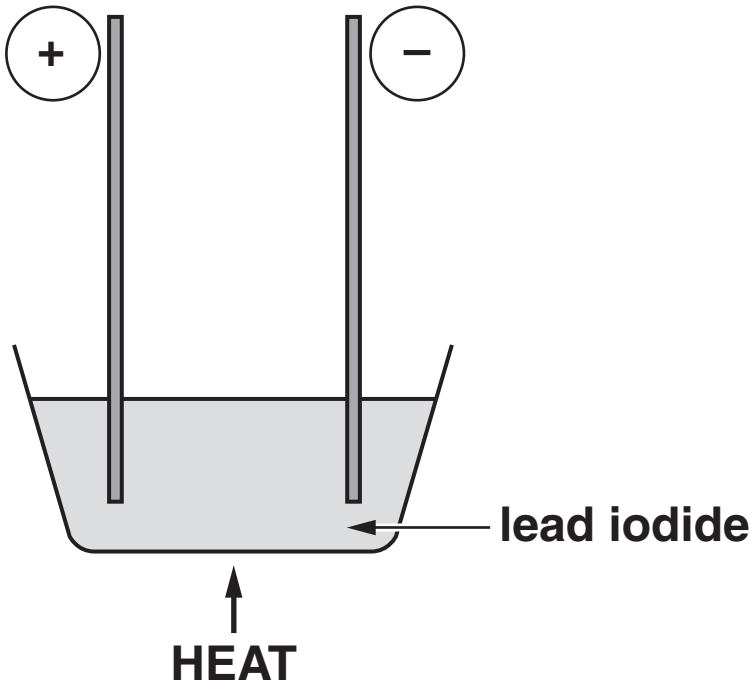
Hydrogen atoms are much lighter than the other atoms. ☐

Hydrogen is a gas, carbon is a solid. ☐

[1]

[Total: 3]

4 **Les sets up an experiment to pass electricity through lead iodide.**



(a) **Why must the lead iodide be heated?**
Put ticks (✓) in the boxes next to the <u>TWO BEST</u> answers.

Heating provides energy for the reaction.	☐
When heated, ionic compounds melt.	☐
Ions in molten compounds can move.	☐
Heating breaks down the compound.	☐
The compound needs to vapourise.	☐

[2]

(b) During the experiment, iodine vapour forms. On cooling, the iodine changes to its normal state at room temperature.

Complete the sentences that describe this change.

Choose words from this list.

BROWN

GREY

LIQUID

ORANGE

PRECIPITATE

PURPLE

SOLID

The colour of iodine vapour is

_____ .

This changes to a

_____ _____

on cooling. [2]

(c) A similar experiment can be carried out using copper bromide or potassium iodide.

The formula for potassium iodide is KI.

Iodide ions have the symbol I^-.

(i) What is the symbol for a potassium ion?

answer _____ [1]

(ii) Copper ions have the symbol Cu^{2+}.
What is the formula for copper bromide?

answer _____ [1]

[Total: 6]

5 Some types of car batteries contain metals such as lead.

(a) Lead can be extracted by heating lead oxide with carbon.

The equation shows what happens when lead oxide is heated with carbon.

$$PbO + C \longrightarrow Pb + CO$$

(i) Which statement about the reaction is true?

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

The reaction involves only oxidation.	☐
The reaction involves only reduction.	☐
The reaction involves both oxidation and reduction.	☐
The reaction does not involve either oxidation or reduction.	☐

[1]

(ii) **Which other metals can be extracted by heating their oxides with carbon?**

Put a (ring) around each of the TWO correct answers.

ALUMINIUM

COPPER

POTASSIUM

SODIUM

ZINC

[2]

(b) Some car batteries also contain small amounts of other metals including lithium and calcium.

(i) Lithium cannot be extracted by heating lithium oxide with carbon.

Which of the statements gives the BEST reason for this?

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

Lithium metal reacts with water.	☐
Lithium oxide is ionic.	☐
Lithium is very reactive.	☐
Lithium oxide has a very high melting point.	☐

[1]

(ii) Lithium and calcium are formed from their ions during electrolysis.

Complete the two equations.

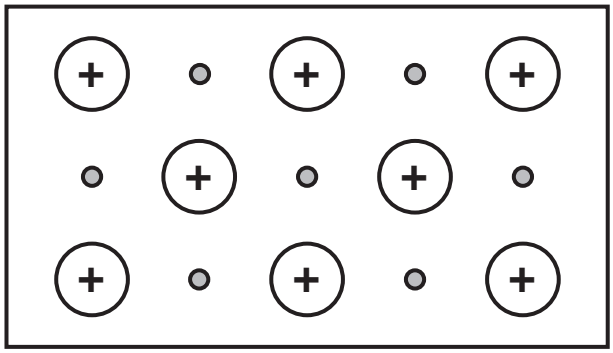
Li^+ + ☐ → Li

Ca^{2+} + ☐ → Ca

[2]

(c) One reason metals are used in batteries is that they are very good electrical conductors.

(i) The diagram shows the structure of a metal.



Use the diagram to help you to describe the structure of this metal.

_____

_____

_____ [2]

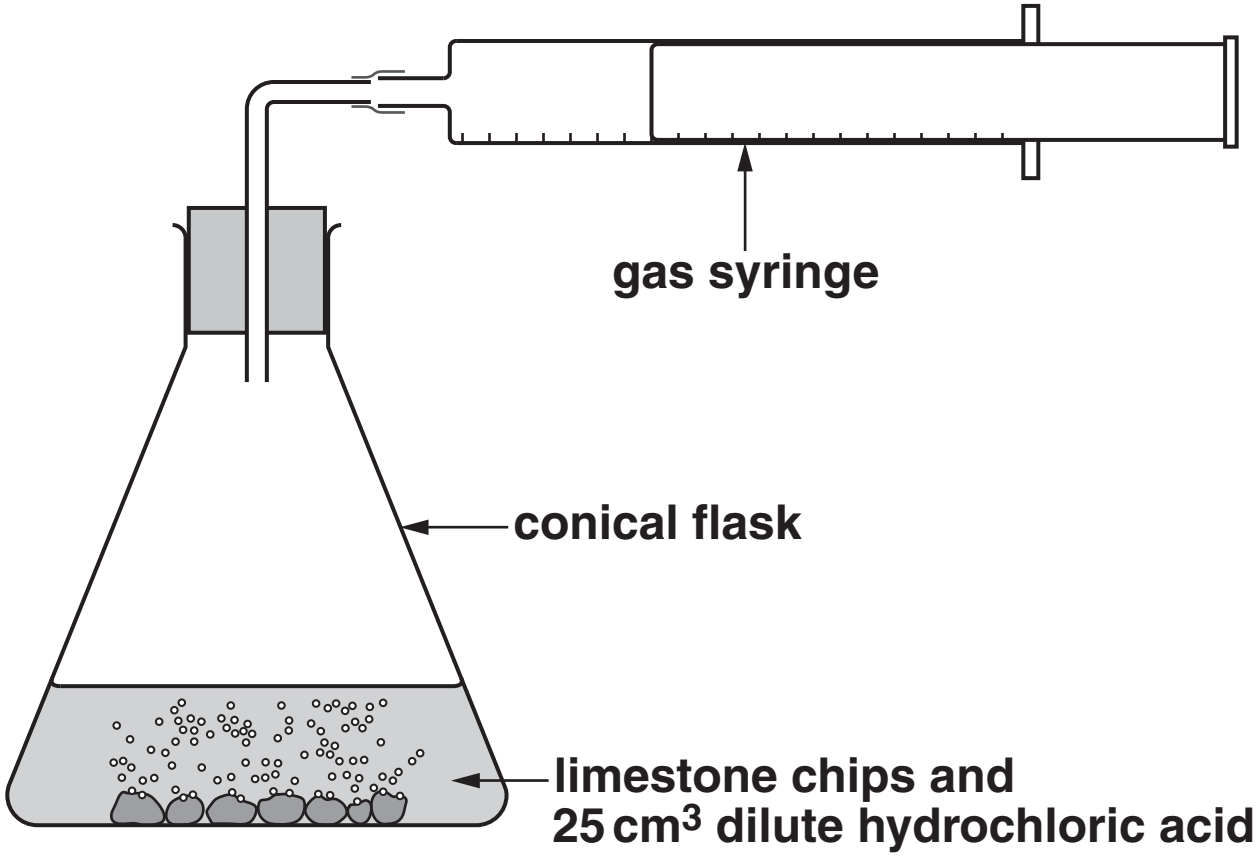
(ii) Suggest why this structure allows metals to be good electrical conductors.

_____

_____ [1]

[Total: 9]

6 Eve carries out an experiment.
She adds 25 cm^3 of dilute hydrochloric acid to limestone chips (calcium carbonate).
Once every 30 seconds she records the total volume of gas that has been given off.



When the reaction ends, lumps of limestone are left in the flask.

The table shows her results.

TIME IN s	TOTAL VOLUME OF GAS IN cm^3
0	0
30	80
60	120
90	140
120	150
150	150

(a) Explain the change in the rate of reaction during the experiment.
Include in your answer

- **how the rate changes**
- **an explanation of why this happens.**

_____

_____

_____

_____ **[3]**

(b) Eve carries out a second experiment using 25 cm^3 of a more concentrated hydrochloric acid solution.

She uses the same amount of limestone chips.

Give TWO ways that the results of the second experiment will be different to the first experiment.

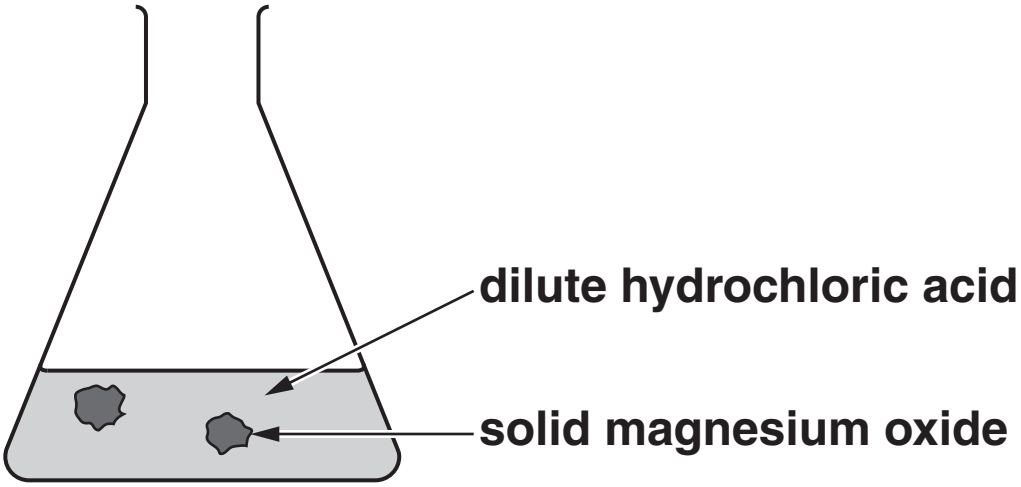
_____

_____ **[2]**

[Total: 5]

7 Joe adds dilute hydrochloric acid to solid magnesium oxide.

The reaction produces a solution of magnesium chloride.



(a) Which of the following statements about the reaction are TRUE and which are FALSE?

Put a tick (✓) in the correct box for each statement.

	TRUE	FALSE
The mixture has a high pH at the start of the reaction.		
The pH stays constant during the reaction.		
Hydrogen is made during the reaction.		
Water is made during the reaction.		

[2]

(b) Joe takes the solution of magnesium chloride and makes some crystals.

He measures his yield.

He uses some of the steps below.

A measure the mass

B dessicate

C crystallise

D evaporate

E titrate

Choose which steps are correct and put them into the correct order.

correct order | | | | |

[2]

(c) Joe carries out more experiments to make other salts.
He makes calcium chloride by reacting calcium hydroxide with dilute hydrochloric acid.

$$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$$

(i) Joe works out what mass of calcium chloride he can make.

The box below shows some of Joe's working.

Complete Joe's working by filling in the gaps.

	RELATIVE ATOMIC MASS
Ca	_____
O	_____
H	_____
Cl	35.5

relative formula mass of $Ca(OH)_2$ = 74

relative formula mass of $CaCl_2$ = _____

[2]

(ii) The reaction between calcium hydroxide and hydrochloric acid is a neutralisation reaction.

Which ion is always present in a solution of an alkali?

Put a (ring) around the correct answer in this list.

Ca^{2+} Cl^{-} H^{+} O^{2-} OH^{-}

[1]

(iii) Write the general equation for a neutralisation reaction by filling in the boxes.

Choose from the formulae in this list.

Ca^{2+} Cl^{-} H^{+} HCl

O^{2-} OH^{-} H_2O $CaCl_2$

[ ] + [ ] → [ ]

[1]

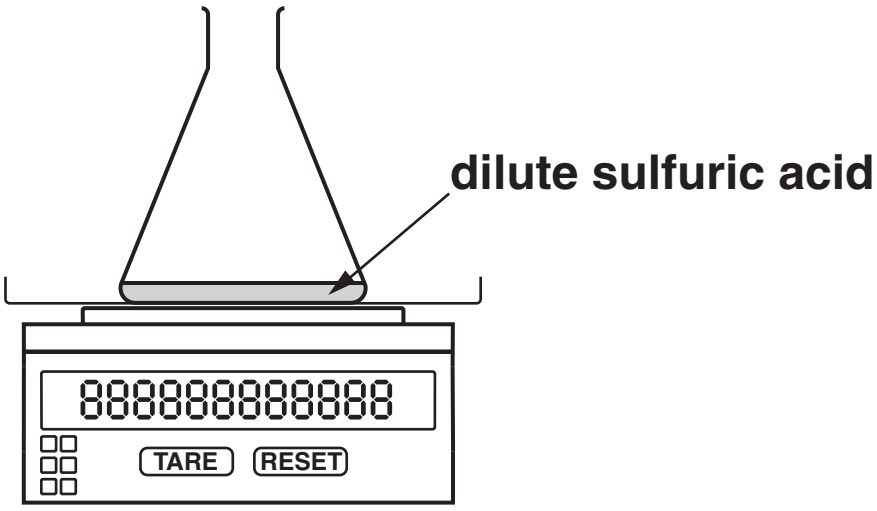
[Total: 8]

8 Sam works for a medicine company.

The company makes zinc sulfate to treat patients who do not have enough zinc in their body.

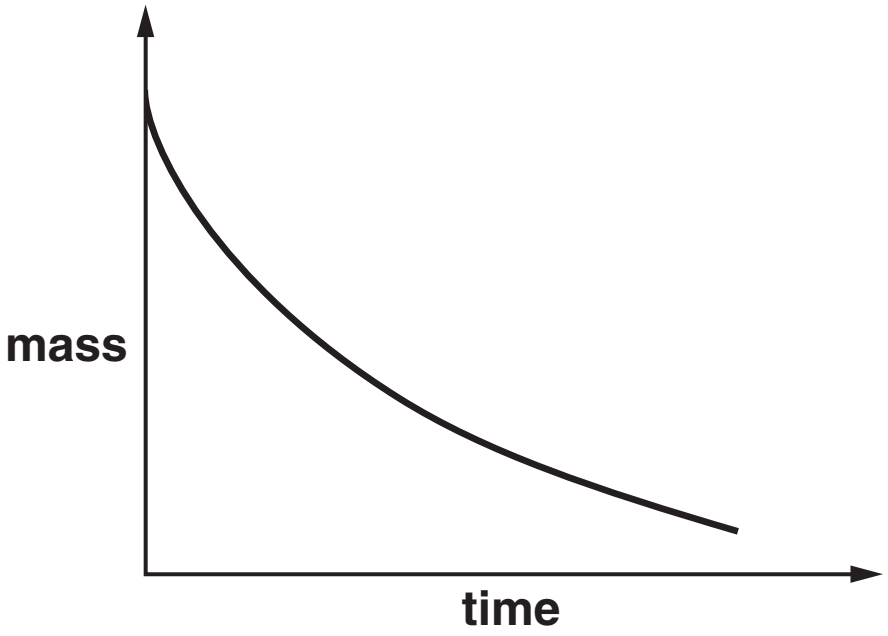
Sam carries out some experiments to find the best method of making zinc sulfate.

She adds different chemicals to dilute sulfuric acid and then measures the mass during each reaction.



EXPERIMENT NUMBER	CHEMICAL ADDED TO SULFURIC ACID
1	zinc metal
2	zinc oxide
3	zinc carbonate
4	zinc hydroxide

Two of her experiments give graphs with this shape.



(a) Which two chemicals give graphs with this shape?

Put a tick (✓) in each of the TWO correct boxes.

zinc metal ☐

zinc oxide ☐

zinc carbonate ☐

zinc hydroxide ☐

[2]

(b) Sam works out how much of each chemical she needs to use to make 2 g of zinc sulfate.

Which chemical is needed in the SMALLEST MASS to make 2 g of zinc sulfate?

Put a (ring) around the correct answer.

ZINC METAL

ZINC OXIDE

ZINC CARBONATE

ZINC HYDROXIDE

[1]

[Total: 3]

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

**** 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.