OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A172/02**

CHEMISTRY A

Unit A172: 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)

Duration: 1 hour

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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of qualitative tests for ions is printed on page **2**.
- The Periodic Table can be found on the back page.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**3**	
2	**2**	
3	**6**	
4	**3**	
5	**4**	
6	**3**	
7	**2**	
8	**6**	
9	**6**	
10	**3**	
11	**2**	
12	**2**	
13	**2**	
14	**12**	
15	**4**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Qualitative Analysis

Tests for positively charged ions

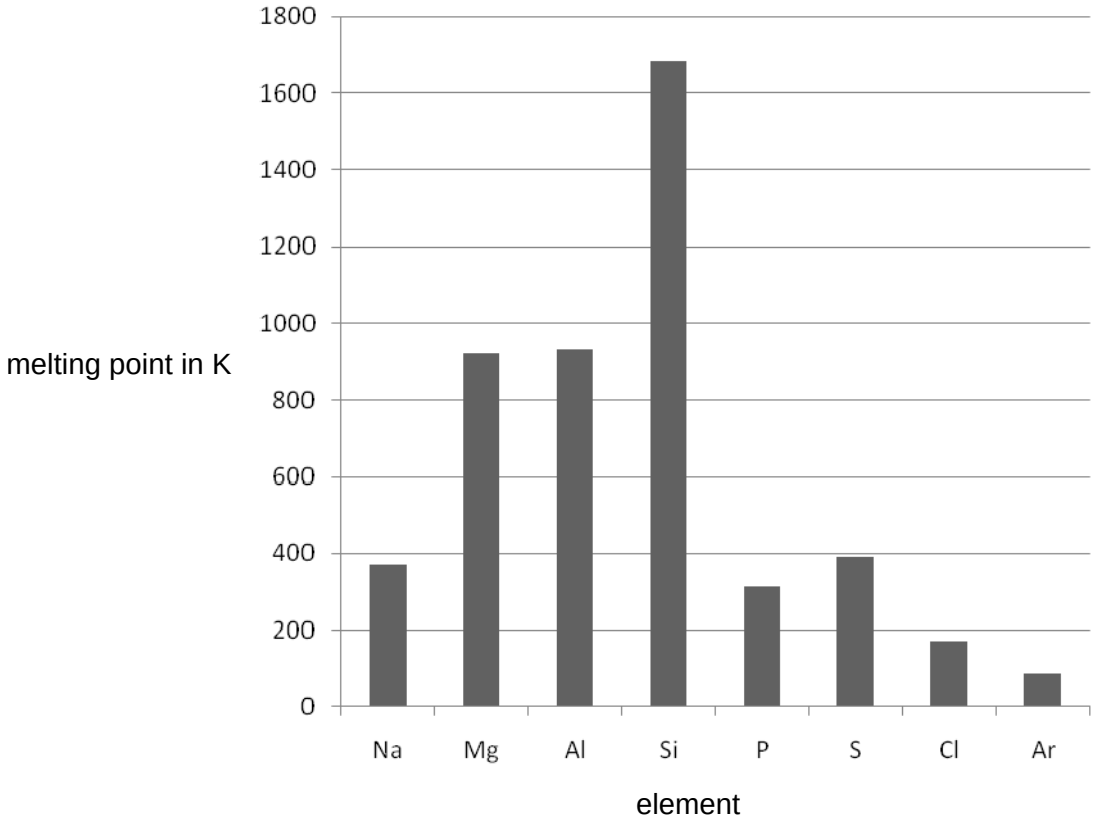
ion	test	observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc Zn^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide

Tests for negatively charged ions

ion	test	observation
carbonate CO_3^{2-}	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride Cl^-	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide Br^-	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide I^-	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate SO_4^{2-}	add dilute nitric acid, then add barium choloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

1 The bar chart shows melting points of elements across the third period of the Periodic Table.



Jack studies these data and makes two conclusions

- the melting points of metals increase from left to right across the Periodic Table
- the melting points of non-metals decrease from left to right across the Periodic Table.

Evaluate how well the data support this conclusion, and suggest what further data you could obtain to support your evaluation.

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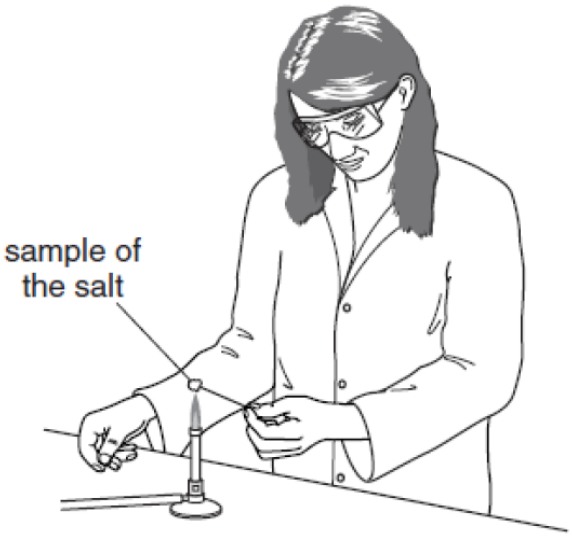
..... **[3]**

[Total: 3]

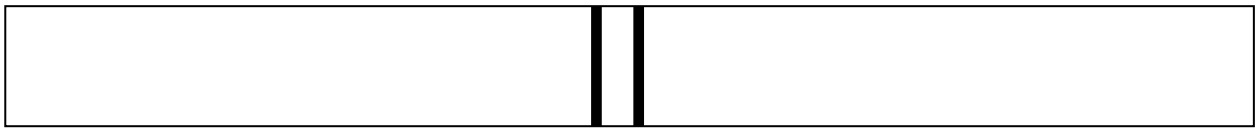
2 Eve tests some salts by doing a flame test.



Eve heats a sodium salt. She sees that it gives off a coloured light.

She looks at the spectrum of light through a spectroscope.

She sees some yellow lines.



yellow lines

Eve then heats a potassium salt and looks at the spectrum of light it gives off.

Write down one **similarity** and one **difference** between the two spectra that Eve sees.

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

[Total: 2]

3 The table shows some information about a sodium atom and a fluorine atom.

name of atom	atomic (proton) number	relative mass	electronic configuration	ion formed by atom
sodium	11	23	2.8.1	Na^+
fluorine	9	19	2.7	F^-

Use the data in the table to describe and explain the difference in structure of a sodium atom and a fluorine atom.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

4 Sodium reacts with the halogens.

The reaction takes place between sodium metal and the halogen in the gas state.

(a) The table shows what happens when hot sodium is put into jars containing different halogen gases.

halogen gas	appearance of halogen gas at start	time for reaction to finish in seconds	appearance of product at end
chlorine	pale green	5	white solid
bromine			
iodine	purple	15	white solid

Complete the table to describe what you would see when sodium is put into a jar containing bromine gas. **[2]**

(b) What is the name and formula of the white solid left at the end of the reaction when sodium reacts with iodine?

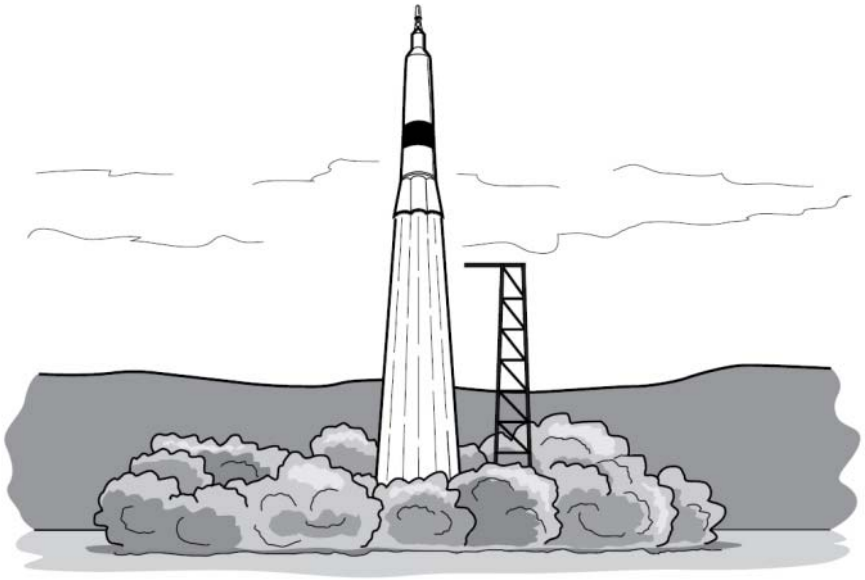
.....

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

[Total: 3]

5 Lithium is an element in Group 1 of the Periodic Table.

It can be added to rocket fuel to give an extra boost for take off.



(a) Lithium works well in rocket fuels because it is very reactive.

Which of the following statements about the reactivity of lithium are **true** and which are **false**?

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

	true	**false**
Lithium reacts with cold water.		
Lithium reacts with other Group 1 elements to form compounds.		
Lithium tarnishes in moist air more quickly than potassium.		
Lithium chloride is very unstable.		

[2]

(b) When the fuel burns, the lithium also burns.

Complete the balanced symbol equation to show what happens when lithium burns.

word equation lithium + oxygen → lithium oxide

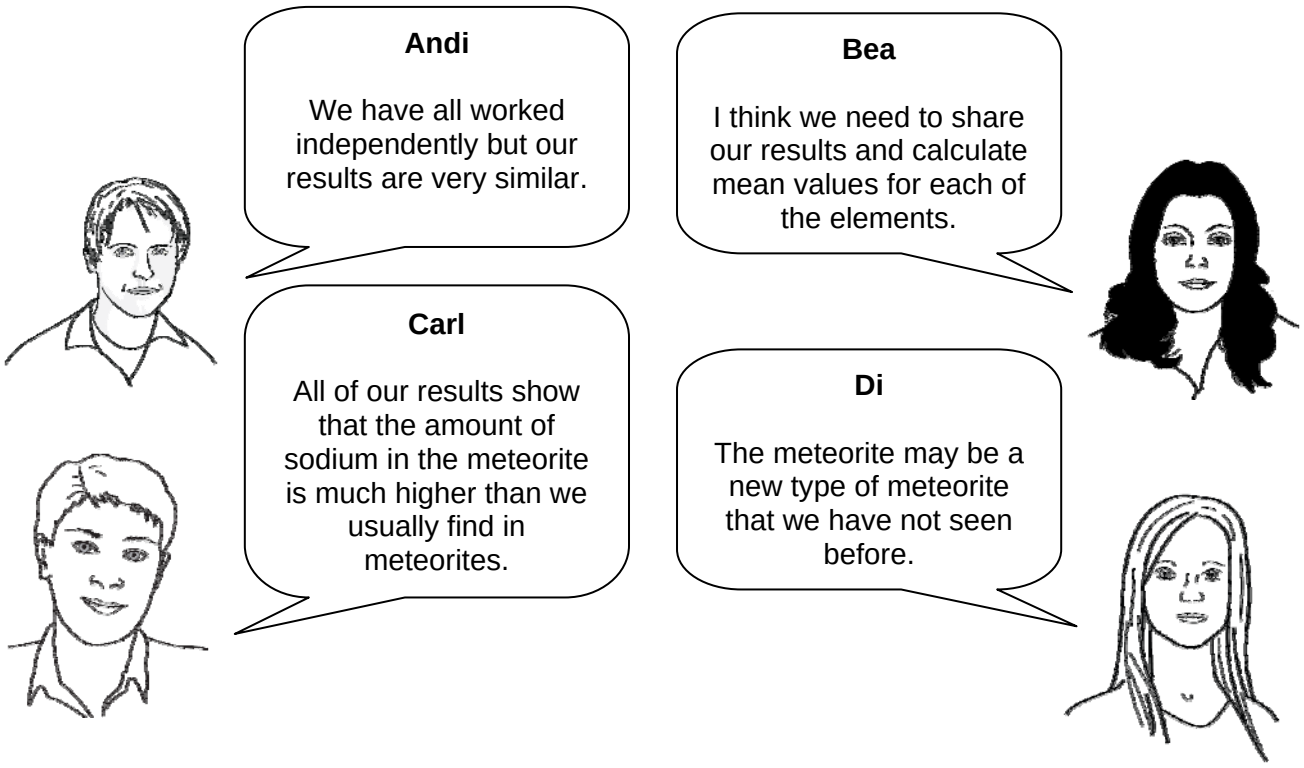
balanced symbol equation ..... + ... → …….Li_2O **[2]**

[Total: 4]

6 Meteorites are small pieces of rock that land on Earth from space.

Four scientists are investigating the amounts of different elements in a meteorite.

They talk about what they find.



(a) Put ticks (✓) in the table to identify who is making each type of statement.

	Andi	**Bea**	**Carl**	**Di**	**none of the scientists**
Who is talking about the reproducibility of data?					
Who is suggesting a hypothesis?					
Who is talking about an outlier?					
Who is making a suggestion that would help to work out a best estimate?					

[2]

(b) Di thinks that the meteorite is a new type of meteorite.

She wants to convince other scientists.

Here are some actions that she could take.

A publish a report in a newspaper so that everyone can see it

B publish a report in a scientific journal so that other scientists can see it

C repeat the experiment to confirm her results before she tells anyone else

D tell everyone immediately because it is important

E ask other scientists to repeat the experiment

F ask other scientists to identify outliers in her data

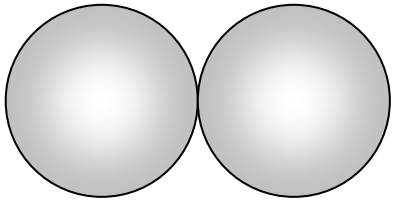
Choose one action from each pair, then write the letters in the boxes to show the order in which she should do them.

start | | | | end

[1]

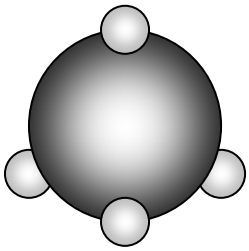
[Total: 3]

7 These diagrams show the arrangement of atoms in a molecule of oxygen and a molecule of methane.



oxygen

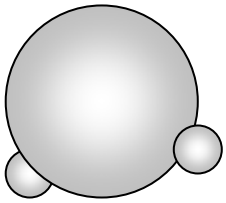
O_2



methane

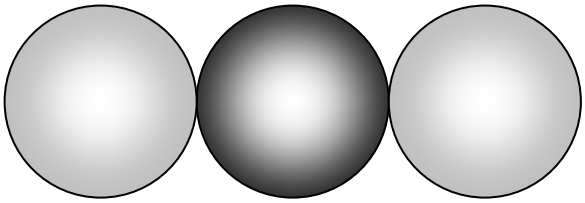
CH_4

What is the name and formula for each of the following molecules?



name .....

formula .....



name .....

formula .....

[2]

[Total: 2]

8 The table shows some properties of a number of metals. For each property the metals are listed from highest value to lowest value.

	melting point	**electrical conductivity**	**density**	**resistance to corrosion**	**cost per tonne**
highest value ↓ **lowest value**	iron	gold	gold	gold	gold
	copper	copper	copper	aluminium	copper
	gold	aluminium	iron	copper	aluminium
	aluminium	iron	aluminium	iron	iron

Electricity is distributed around the country along metal transmission lines.

These lines are hung from pylons.

Which metal would be the best choice for the electrical transmission lines?

Explain fully the reasons for your choice.

The quality of written communication will be assessed in your answer to this question.

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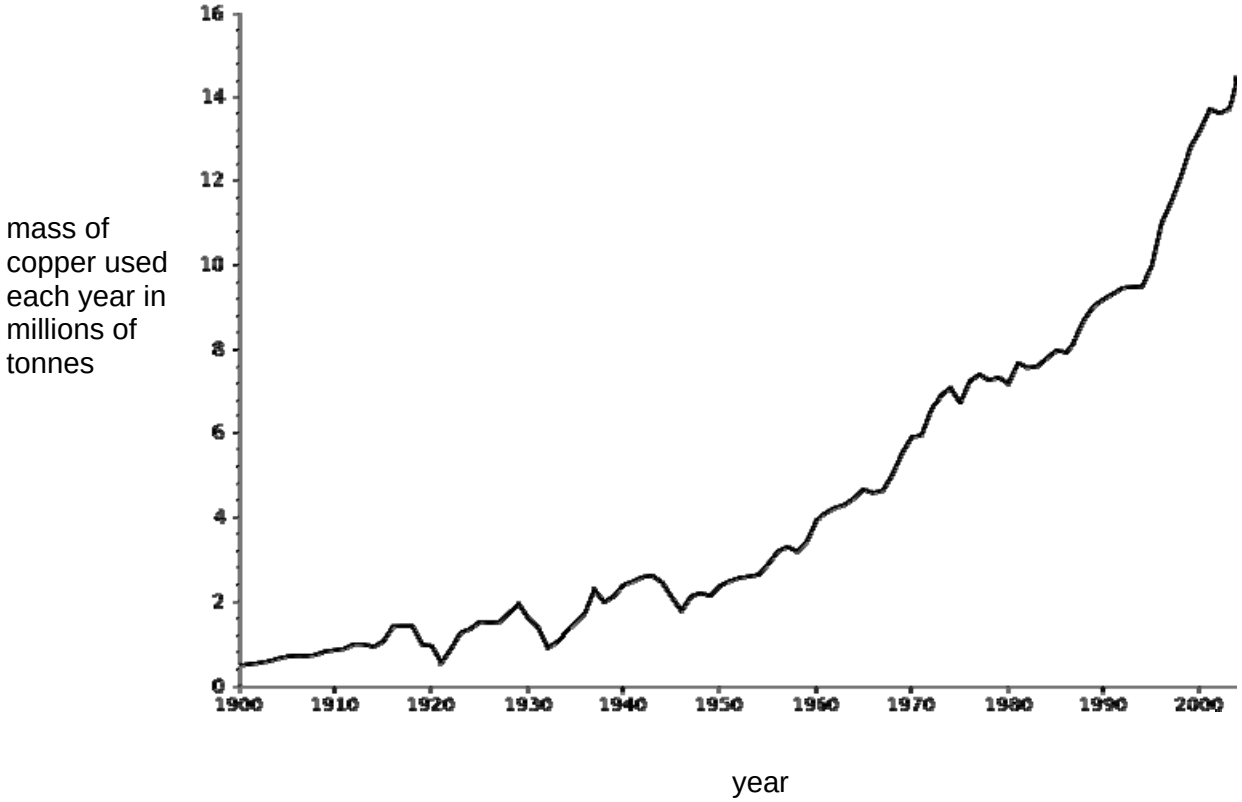
..... **[6]**

[Total: 6]

9 The graph shows the mass of copper used each year during the last century.



Copper is a fairly common metal. It accounts for approximately 0.007 % of the Earth's crust.

(a) (i) Use your knowledge of copper extraction and the graph to predict whether we will be able to produce enough copper to meet demand in the future.

Explain your answer.

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.....

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

(ii) Suggest how it might be possible to reduce the mass of copper that we need to extract each year.

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

(b) Copper is obtained by mining copper ores from the ground.

A mining company can recover 40 g of copper ore from every kilogram of mined rock.

The ore they recover is called cuprite, and has the formula Cu_2O.

(i) What is the maximum amount of copper **metal** the company will be able to recover from a kilogram of mined rock?

answer = ... g **[2]**

(ii) Complete the sentences to explain how copper metal can be extracted from cuprite.

Cuprite ore is …… with carbon.

Copper is …… during the reaction because

it loses …… .

Carbon is …… during the reaction because

it gains …… .

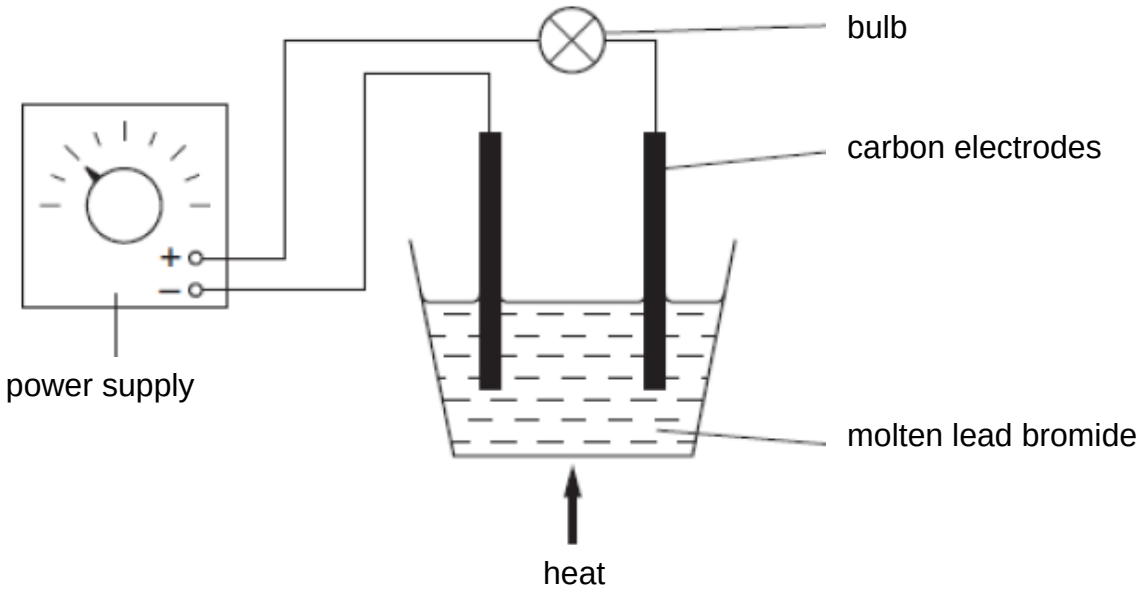
[1]

[Total: 6]

10 John does an experiment.

He passes electricity through molten lead bromide.

The diagram shows how he sets up his experiment.



(a) Lead bromide is an ionic compound.

What will form at each electrode when John turns on the power supply?

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

(b) John finds out that atoms of sodium metal can be made from sodium chloride by electrolysing molten sodium chloride.

Complete the equation to show what happens when a sodium ion forms a sodium atom.

Na^+ + ... → ..... **[1]**

[Total: 3]

11 Silicon dioxide is a giant molecular compound.

The atoms in silicon dioxide are held together by covalent bonds.

Which statements about the bonding in silicon dioxide are correct?

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

Electrons are gained or lost to form a full outer shell.	☐
Electrons are shared between atoms.	☐
The nucleus of each bonded atom attracts electrons.	☐
Charged ions are attracted towards one another.	☐
The nuclei of the atoms attract each other.	☐

[2]

[Total: 2]

12 This question is about solids and liquids.

(a) Which is the solid acid in this list?

Put a (ring) around the correct answer.

ethanoic acid **nitric acid** **sulfuric acid** **citric acid**

[1]

(b) Baking powder contains small grains of a solid acid and small grains of a solid alkali.

The acid in baking powder does not react with the alkali until water is added.

Explain why the reaction only starts when water is added.

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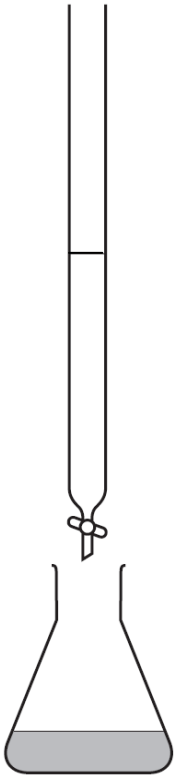
..... **[1]**

[Total: 2]

13 Mary does a titration.



She puts 25.0 cm^3 of alkali solution in a conical flask. She adds a few drops of indicator to the alkali and then adds acid from the burette.

She does a rough titration first. She then does an accurate titration.

Describe one thing Mary should do to make her second titration as accurate as possible, and explain why this increases the accuracy.

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

[Total: 2]

14 Bobby reacts 3 g of magnesium pieces with an excess of sulfuric acid until all of the magnesium has reacted.

$$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$

(a) What mass of magnesium sulfate will be produced by the reaction?

Show your working.

mass of magnesium sulfate = ... g **[2]**

(b) Bobby collects the hydrogen gas produced by the reaction. Every 10 seconds he records the volume of gas that has been collected.

Here are his results.

time after start of reaction in s	volume of gas collected in cm^3
0	0
10	20
20	30
30	35
40	35
50	35

What was the rate of reaction during the first 10 seconds?

Show your working and include appropriate units in your answer.

rate of reaction = ... **[1]**

(c) Bobby does the experiment a further four times.

Each time he makes **one** change to the way he does the experiment.

experiment	volume of gas collected after 10s, in cm^3	volume of gas collected after 30s, in cm^3	volume of gas collected after 50s, in cm^3
original experiment	20	35	35
experiment **A**	35	40	40
experiment **B**	30	35	35
experiment **C**	20	30	35
experiment **D**	25	35	35

In which experiment did Bobby use a larger mass of magnesium pieces?

Explain your answer.

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..... **[3]**

(d) Bobby does the experiment one more time. This time, he uses smaller pieces of magnesium.

How will this change the rate of the reaction?

Explain your answer.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 12]

15 Geoff reacts copper carbonate with hydrochloric acid.

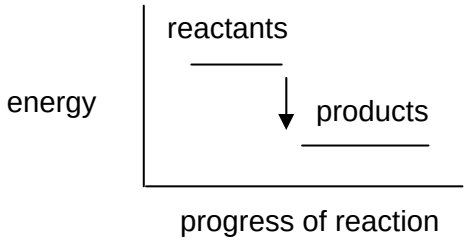
He knows that this will produce a salt and two other products.

(a) Write the formula of each chemical in the correct box, then balance the equation.

$CuCO_3$	+		→	$CuCl_2$	+		+	

[3]

(b) Geoff draws an energy level diagram for the reaction.



What is the name given to this type of reaction?

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

[Total: 4]

[Paper Total: 60]

END OF QUESTION PAPER

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Periodic Table

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.***

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RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A **A172/02**

Unit A172: Modules C4, C5, C6 (Higher Tier)

MARK SCHEME

MAXIMUM MARK 60

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ORA = or reverse argument

   Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. Annotations:
   The following annotations are available on SCORIS.

   ✓ = correct response
   ✖ = incorrect response
   bod = benefit of the doubt
   nbod = benefit of the doubt **<u>not</u>** given
   ECF = error carried forward
   ^ = information omitted
   I = ignore
   R = reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	✓
☐	☐	✓
✓	✓	☐
✓	✓	☐
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Mark	Additional guidance
1			*metals:* the conclusion is supported but the melting point of Al is only slightly higher than Mg *non-metals:* the conclusion is supported for S, Cl and Ar but P is lower than S / P does not follow the trend could collect data for other periods to help evaluate the conclusions	[3]	**allow** S not following trend
			Total	[3]	

Question			Expected answers	Mark	Additional guidance
2			the similarity is that they will both have lines the difference is that the lines will be different colours / the lines will be in different places / the lines will be in a different pattern	[2]	
			Total	[2]	

Question			Expected answers	Mark	Additional guidance
3	(a)	✎	**[Level 3]** Most of the properties are discussed with clear comparison made. Discusses nuclear content, electron configuration and ions using actual numbers of particles /shells. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Compares structure of nucleus, electronic structure and ions. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Some structure described but clear comparison may not be made. Discusses structure of nucleus and / or electronic configuration. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • sodium has one electron in the outer shell, fluorine has 7 • sodium has 3 electron shells, fluorine has 2 • sodium has 11 protons, fluorine has 9 • sodium has 12 neutrons, fluorine has 10 • when sodium forms an ion it loses an electron • when fluorine forms an ion it gains an electron • both ions have a stable electron arrangement / full outer shell for Level 2, **accept** 'different numbers of protons / neutrons / electron shells'
			Total	**[6]**	

Question			Expected answers	Mark	Additional guidance
4	(a)		orange gas at start and white solid at end reaction takes 8-12 s / slower than iodine but faster than chlorine	[2]	
	(b)		sodium iodide NaI	[1]	both required for the mark, in either order
			Total	[3]	

Question			Expected answers			Mark	Additional guidance
5	(a)			**true**	**false**	[2]	all 4 correct = 2 2 or 3 correct = 1 1 or 0 correct = 0 **accept** other indications of choice (eg lines or crosses)
			… reacts with cold water.	✓			
			… to form compounds.		✓		
			… more quickly than potassium.		✓		
			… is very unstable.				
	(b)		Li and O_2 as reactants correct balancing			[2]	the completed equation will be: $4Li + O_2 \rightarrow 2Li_2O$
			Total			[4]	

<table>
<tr><th colspan="3">Question</th><th>Expected answers</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>Andi</th><th>Bea</th><th>Carl</th><th>Di</th><th>none</th></tr>
<tr><td>...reproducibility</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>...hypothesis</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>...outlier</td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>...best estimate</td><td></td><td>✓</td><td></td><td></td><td></td></tr>
</table>
</td><td>[2]</td><td>all four correct = 2
3 or 2 correct = 1
1 or 0 correct = 0</td></tr>
<tr><td></td><td>(b)</td><td></td><td>C E B</td><td>[1]</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[3]</td><td></td></tr>
</table>

Question			Expected answers	Marks	Additional guidance
7			water, H_20 carbon dioxide, $C0_2$	[2]	**credit** 1 mark for any two names/formulae correct
			Total	[2]	

Question			Expected answers	Mark	Additional guidance
8			**[Level 3]** Chooses aluminium and uses its properties to explain suitability. Uses properties of other metals to explain their lack of suitability. Refers to compromise of properties for purpose. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Chooses aluminium and uses its properties to explain suitability. Makes some reference to properties of other metals but does not explain their lack of suitability. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Chooses a metal other than aluminium. Makes some relevant comments about its suitability. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • aluminium has lowest density so cable can span long distances • aluminium has good resistance to corrosion so cables will last a long time • aluminium has reasonable conductivity but this is a compromise • aluminium is quite cheap so lots of cables can be used for reasonable cost • gold has very good conductivity but is too heavy and is too expensive • iron is cheap but is too heavy and corrodes too easily • copper has good conductivity but is too heavy and too expensive
			Total	**[6]**	

Question			Expected answers	Mark	Additional guidance
9	(a)	(i)	the (trend shown in the) graph suggests that use of/demand for copper will continue to increase however, large amounts of ore need to be mined to recover a small percentage of copper so we may not be able to mine enough ore to meet the demand / only a small proportion of the copper in the Earth's crust is close enough to the surface to be mined economically	[2]	for full marks the explanation must be expressed in a logical coherent order
		(ii)	used copper could be recycled	[1]	
	(b)	(i)	$\frac{63.5 + 63.5}{63.5 + 63.5 + 16} \times 40$ = 35.5	[2]	
		(ii)	heated reduced oxygen oxidised oxygen	[1]	all correct for the mark **reject** "reacted" / "mixed" / "treated" etc.
			Total	[6]	

Question			Expected answers	Mark	Additional guidance
10	(a)		lead and bromine form lead at the negative electrode and bromine at the positive electrode	[2]	
	(b)		e^- and Na	[1]	both required for the mark
			Total	[3]	

Question			Expected answers	Mark	Additional guidance
11			Electrons are shared between atoms. ✓ The nucleus of each bonded atom ... ✓	[2]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
12	(a)		**citric acid**	[1]	
	(b)		the acid and alkali need to dissolve in water to produce H^+ (aq) and OH^- (aq) ions (which are free to react)	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
13			she should add acid in small amounts near the end point so that she does not add more acid than necessary to neutralise the alkali **OR** she should swirl the flask between each addition of acid so that the acid mixes completely before adding any more **OR** she should look carefully for first (permanent) colour change so that she does not add more acid than necessary to neutralise the alkali	[2]	**ignore** "do it (more) carefully" for full marks the action Mary takes should be coherently linked to the resulting improvement in accuracy
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
14	(a)		gram formula mass of $MgSO_4$ = 24 + 32 + 64 = 120 g gram formula mass of Mg = 24 g $\frac{3}{24}$ x 120 = 15	[2]	
	(b)		20 ÷ 10 = 2 cm^3/s	[1]	correct working, answer and units required for the mark
	(c)		experiment **A** because a larger mass of magnesium pieces will give a higher rate of reaction, so more gas will have been produced by 10s and a larger mass of reactant will produce a greater volume of product/gas/hydrogen	[3]	for full marks the explanation must be expressed in a logical and coherent order

Question			Expected guidance	Gd	Additional guidance
14	(d)	✎	**[Level 3]** Answer demonstrates an understanding of the nature of the particles involved and the effect of their collisions on the rate of reaction. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Answer deals with one aspect, eg collision frequency, but does not discuss the nature of the colliding species. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Answer shows an awareness of the basic premise, that of collisions, but has difficulty identifying the reacting species and sees the reaction in terms of number of collisions rather than frequency. Detail of what constitutes a low-level answer. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • hydrogen/H^+ ions from the acid • react with magnesium atoms • at the surface of the magnesium • using smaller pieces of magnesium gives a larger surface area • allowing the hydrogen/H^+ ions to collide more frequently with the magnesium atoms • which will increase the rate of reaction **reject** references to increased speed of movement **reject** references to increased concentration of the acid
			Total	**[12]**	

Question			Expected answers	Marks	Additional guidance
15	(a)		HCl in reactant box H_2O and CO_2 in product boxes, in either order equation correctly balanced	[3]	the completed equation will be: $CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$
	(b)		exothermic	[1]	
			Total	[4]	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1			3	**3**
2	1	1		**2**
3✎	3	3		**6**
4(a)	1	1		**2**
4(b)	1			**1**
5(a)	2			**2**
5(b)	1	1		**2**
6(a)		2		**2**
6(b)	1			**1**
7	1	1		**2**
8✎		3	3	**6**
9(a)(i)			2	**2**
9(a)(ii)		1		**1**
9(b)(i)		2		**2**
9(b)(ii)	1			**1**
10(a)		2		**2**
10(b)	1			**1**
11	2			**2**
12(a)	1			**1**
12(b)		1		**1**
13	2			**2**
14(a)		2		**2**
14(b)		1		**1**
14(c)		2	1	**3**
14(d)✎	4	2		**6**
15(a)	2	1		**3**
15(b)	1			**1**
Totals	**25**	**26**	**9**	**60**