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 ions with a positive charge

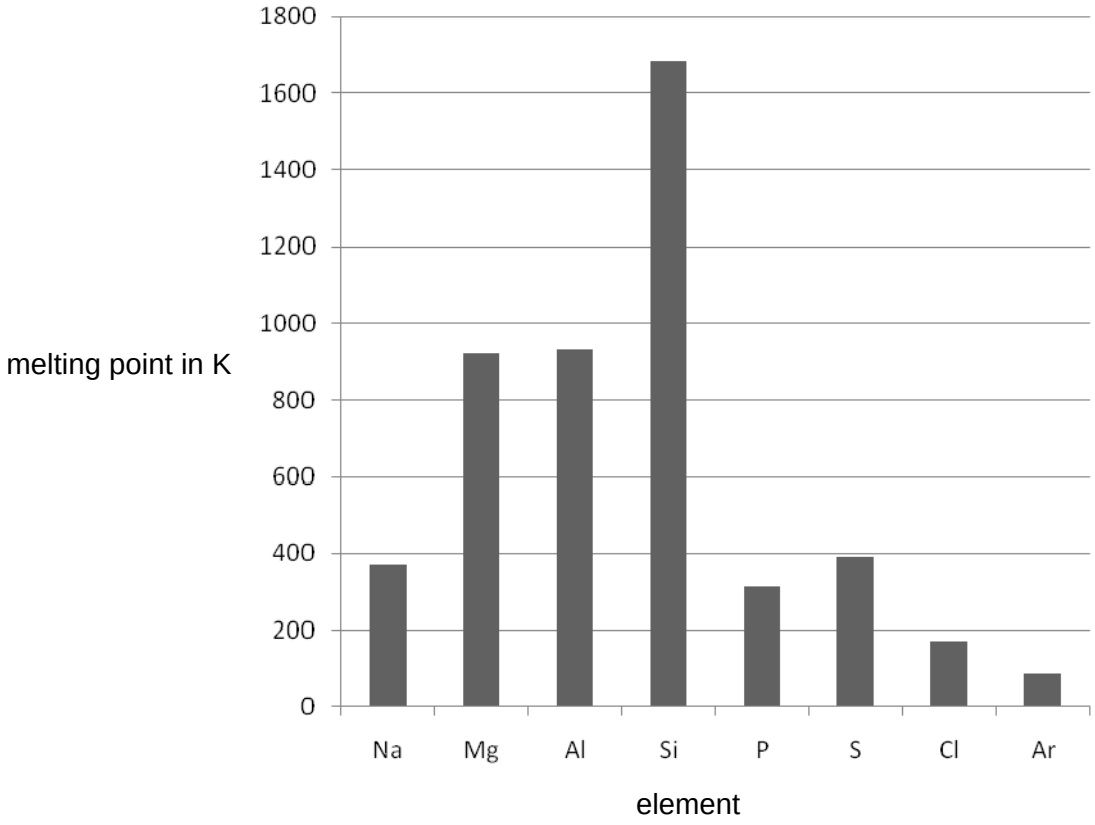
Ion	Test	Observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	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 dissolves in excess sodium hydroxide

Tests for ions with a negative charge

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 acid, then add barium chloride 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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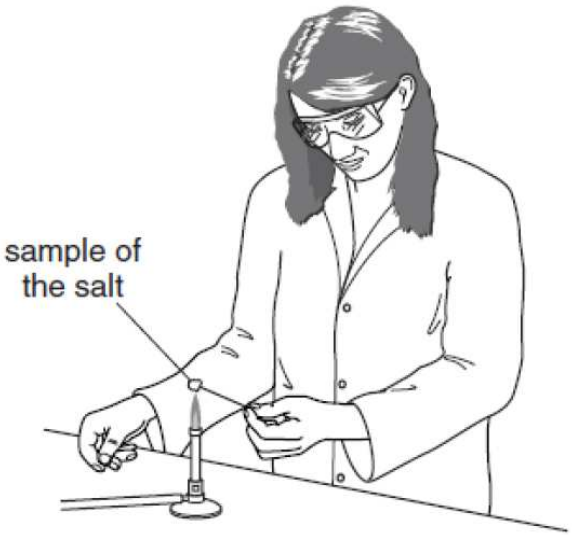
.....**[3]**

[Total: 3]

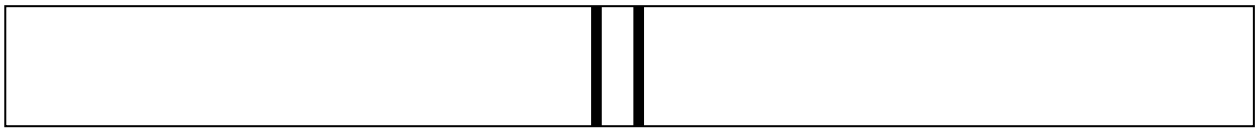
2 Eve tests some salts by doing a flame test.



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?

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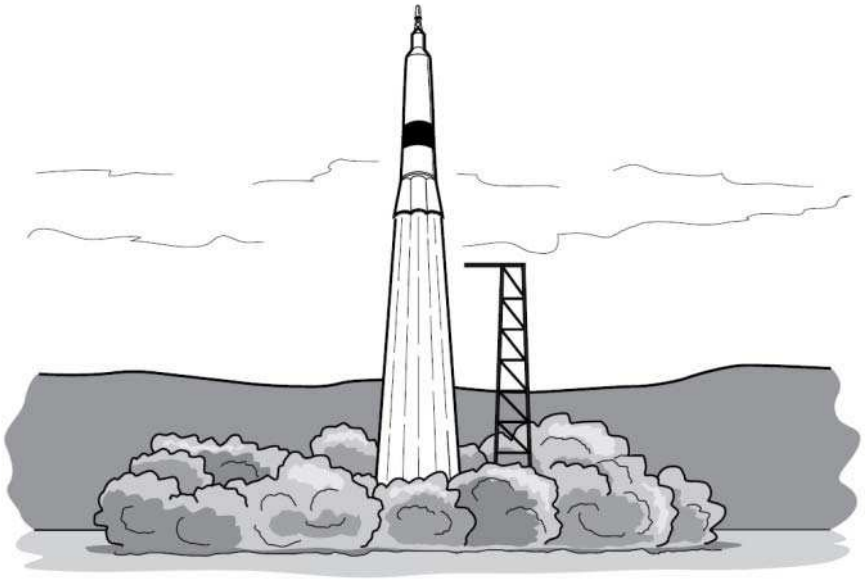
..... **[1]**

[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

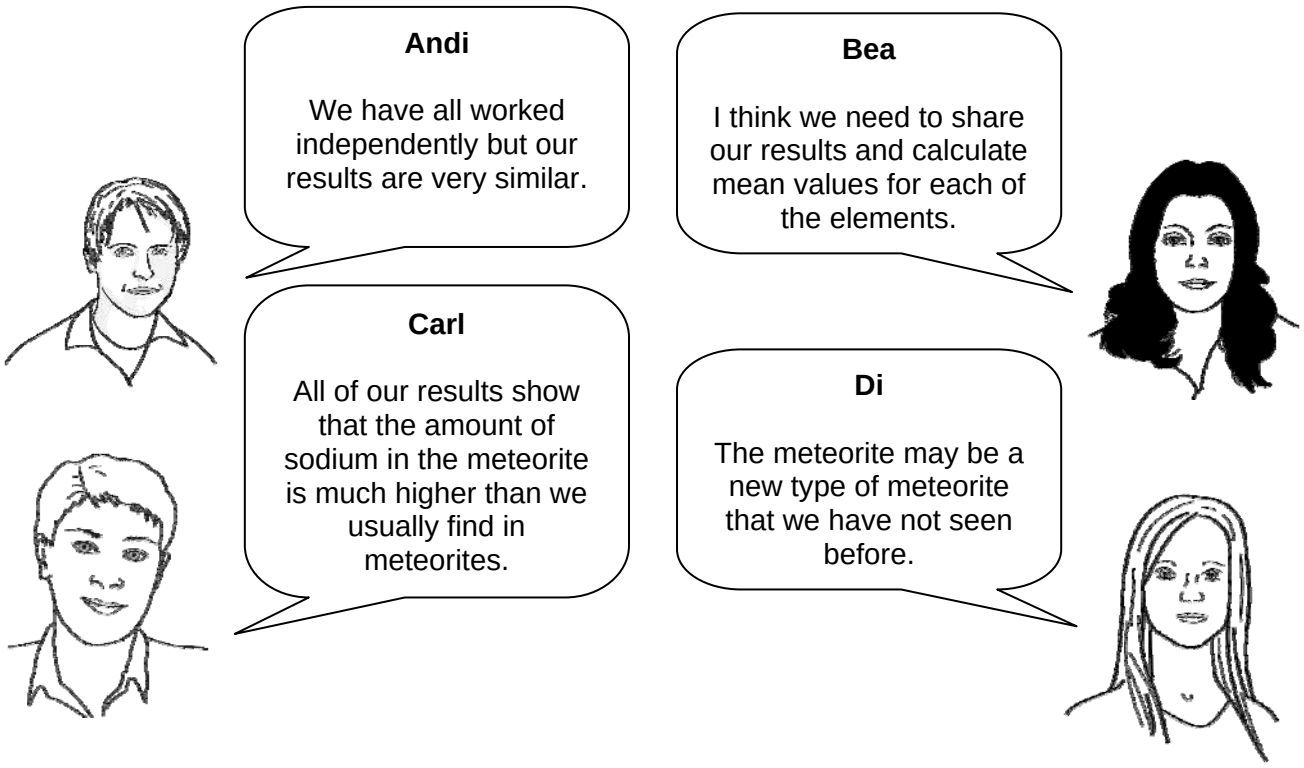
balanced symbol equation ..... + ... → …….Li_2O **[2]**

[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

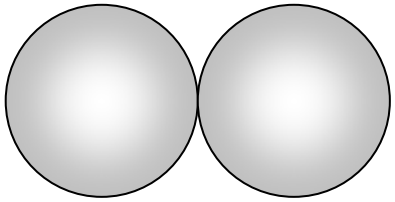
Choose one action from each pair, then write the letters in the boxes to show the order in which she should do them.

start | | | | end

[1]

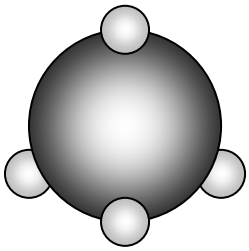
[Total: 3]

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



oxygen

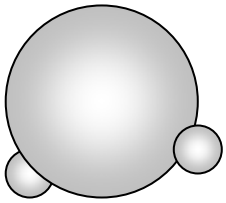
O_2



methane

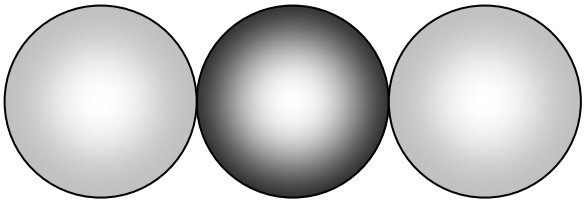
CH_4

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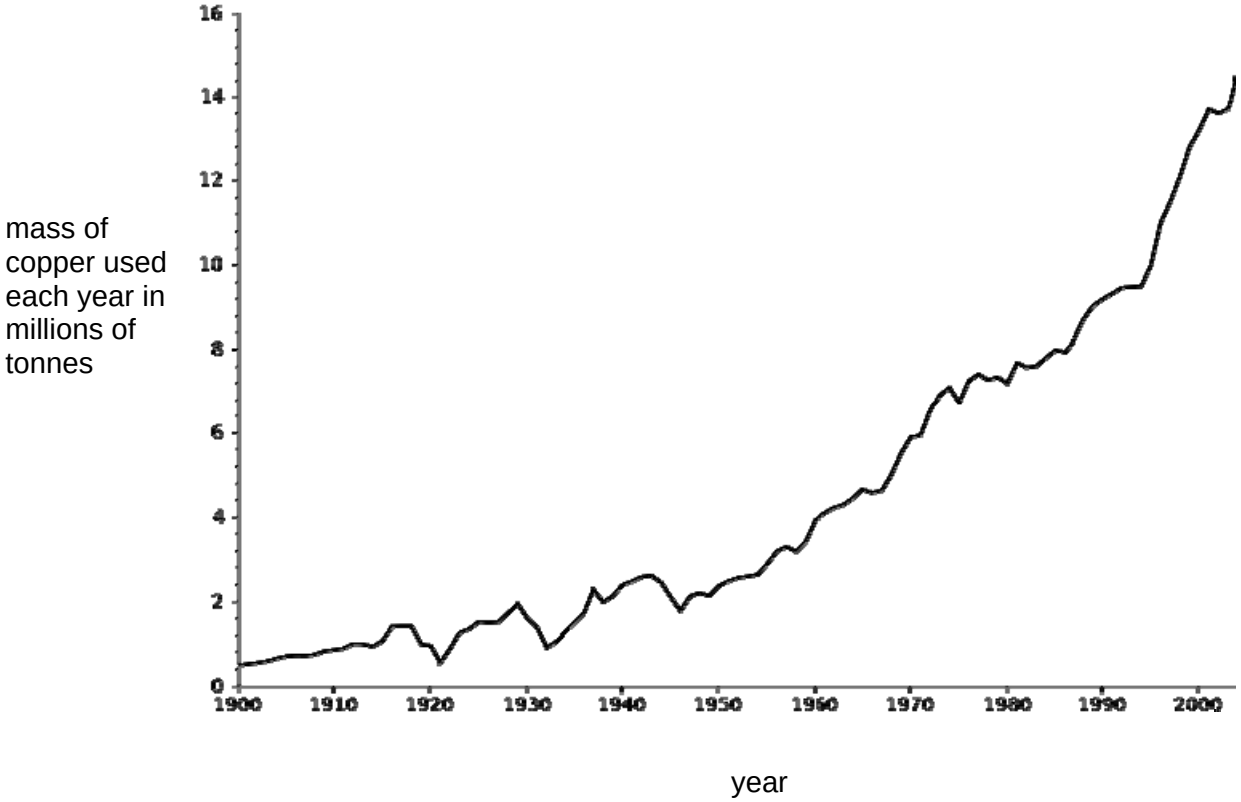
..... **[6]**

[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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..... **[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 …… .

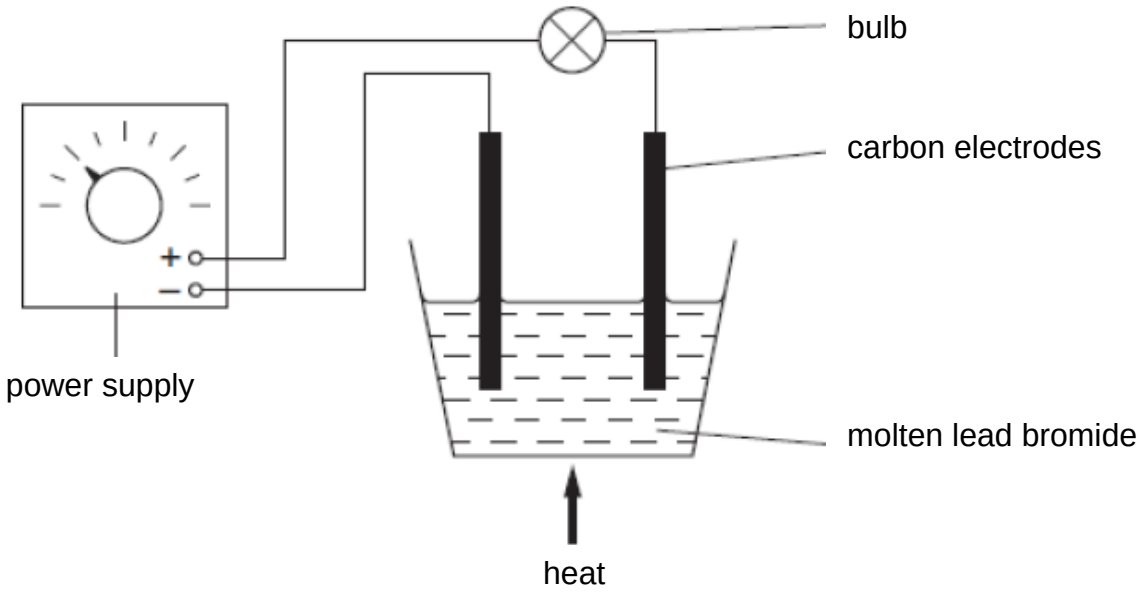
[1]

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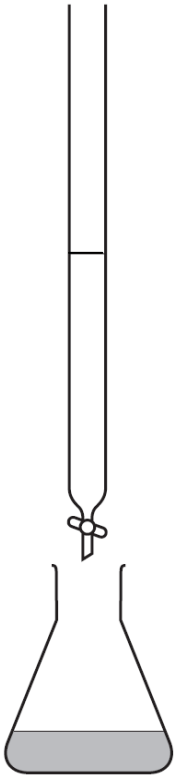
..... **[1]**

[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.

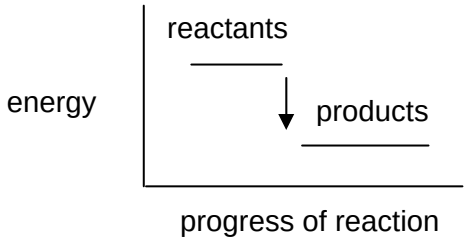
He knows that this will produce a salt and two other products.

(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 **A***l* aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C***l* 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 **T***l* 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.***