

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A172/01

CHEMISTRY A

Unit A172: Modules C4, C5, C6 (Foundation 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	
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Centre Number						Candidate Number				
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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 **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	Mark
1	4	
2	2	
3	3	
4	10	
5	8	
6	5	
7	3	
8	3	
9	5	
10	2	
11	8	
12	7	
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 chloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

- 1 The table shows the melting points of some elements in Group 1.

element	melting point in °C
lithium	180
sodium	97
potassium	
rubidium	39

- (a) Describe the pattern shown by the data in the table.

.....
 [1]

- (b) Use the data in the table to predict the melting point of potassium.

Draw a (ring) around the correct answer.

15°C 39°C 63°C 75°C [1]

- (c) Erica searches on the internet to find out the melting point of potassium.

She finds data from an experiment in which the melting point of potassium was measured five times.

The five results are all different.

Put ticks (✓) in the boxes next to the **two** statements that explain this.

Websites are always wrong.

We can never be sure that any measurement tells us the true value.

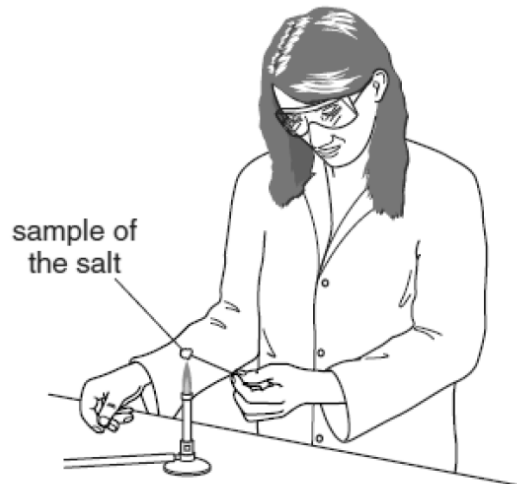
The apparatus used to take the measurements must have been faulty.

If we make several measurements of any quantity, these are likely to vary.

[2]

[Total: 4]

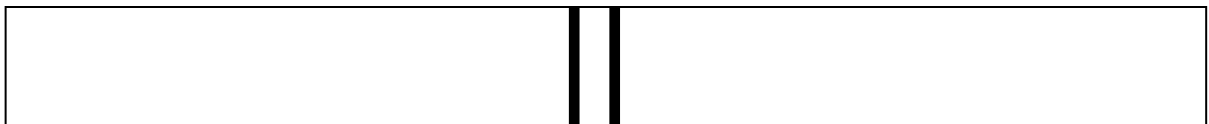
2 Eve tests some salts by doing a flame test.



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.

.....

.....

.....

..... [2]

[Total: 2]

3 The table shows information about some atoms.

name	group in Periodic Table	electron arrangement	number of electrons in outer shell
lithium	1	2.1	1
sodium	1	2.8.1	
fluorine	7	2.7	7
chlorine	7	2.8.7	7

(a) How many electrons does sodium have in its outer shell?

answer [1]

(b) Iodine is another element in Group 7.

(i) Suggest how many electrons iodine has in its outer shell.

answer [1]

(ii) Explain your answer to part (i).

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

[Total: 3]

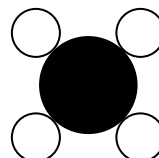
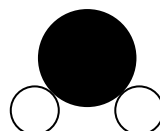
4 This question is about the Group 7 elements, known as the halogens.

(a) The symbol for a bromine molecule is



Which of the diagrams shows a bromine molecule?

Draw a (ring) around the correct answer.



[1]

(b) Hot sodium metal will react with halogens in the gas state.

(i) A piece of hot sodium metal is put into a jar of chlorine gas.

A fast reaction happens and a white solid salt forms.

Write a word equation for this reaction.

..... [1]

(ii) Sodium reacts with other halogens too.

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) The sentences below show some uses of gold.

Each use depends on a different property.

Draw straight lines to connect each **use** to the **property** that allows this use.

use	property
Car air bags have gold electrical contacts.	Gold is very unreactive.
Jewellery can be made by shaping gold wires.	Gold can be bent easily.
Some people have gold fillings in their teeth.	Gold is a good conductor.

[2]

[Total: 8]

- 6 Most electrical wiring is made from copper. The copper used to make the wires is obtained by mining copper ores from the ground.

The photograph shows a copper mine.



© istockphoto.com

A mining company wants to open a new copper mine.

Tests at the site for the new mine show that the company will be able to recover 40 g of copper metal from every kilogram of mined rock.

- (a) What percentage of the mined rock is copper?

answer = % [1]

- (b) Copper is present in the rock as cuprite, a copper ore with the formula Cu_2O .

What is the percentage mass of copper in cuprite?

Relative atomic masses are given in the Periodic Table on the back page.

Show your working.

answer = % [2]

- (c) Suggest why there is a difference between your answers for parts (a) and (b).

.....

..... [1]

(d) Cuprite, Cu_2O , is an oxide of copper.

Suggest how copper could be extracted from cuprite.

..... [1]

[Total: 5]

7 The table shows some information about five different chemicals.

The chemicals are shown by the letters **A**, **B**, **C**, **D** and **E**.

chemical	melting point in °C	boiling point in °C	does it conduct electricity when it is a solid?	does it conduct electricity when it is a liquid?
A	-95	69	no	no
B	1261	2239	no	yes
C	1240	2100	yes	yes
D	1650	2230	no	no
E	-138	0	no	no

(a) Silicon dioxide is a compound with a very high melting point and boiling point. It does not conduct electricity in either the solid or molten state.

Which chemical is most likely to be silicon dioxide?

Put a (ring) around the correct answer.

A **B** **C** **D** **E**

[1]

(b) Chemical **C** is a metal.

Which statement describes how the data in the table show this?

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

Chemical **C** has a high melting point.

Chemical **C** has a high boiling point.

Chemical **C** conducts electricity when it is a solid.

Chemical **C** conducts electricity when it is a liquid.

[1]

(c) Which of the chemicals is an ionic compound?

Put a (ring) around the correct answer.

A **B** **C** **D** **E**

[1]

[Total: 3]

8 Diamond and graphite are two forms of carbon.

The table gives some information about diamond and graphite.

	melting point in °C	density in g/cm ³	hardness	does it conduct electricity?
diamond	3823	3.51	very hard	no
graphite	3925	2.25	soft	yes

(a) Use ideas about the bonding in diamond and graphite to explain the difference in their electrical conductivity.

.....

.....

..... [2]

(b) Which form of carbon could be used in the middle of a pencil?

Use ideas about properties to explain why this form of carbon is suitable for this purpose.

.....

..... [1]

[Total: 3]

9 John knows that there is more than one type of salt.

He makes some salts using different reactants.

(a) Draw a straight line to link each set of **reactants** to the **salt formed**.

reactants	salt formed
sodium hydroxide and hydrochloric acid	magnesium chloride
magnesium hydroxide and hydrochloric acid	sodium chloride
magnesium oxide and sulfuric acid	magnesium sulfate

[2]

(b) The salt that John makes is dissolved in a flask of water.

Solid impurities are in the bottom of the flask.

Explain how he could make clean, dry crystals of his salt.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 5]

10 This question is about solids and liquids.

(a) Which of these chemicals will be a **solid** at room temperature and pressure?

Put a (ring) around the correct answer.

hydrochloric acid

carbon dioxide

hydrogen

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.

What does the water do to the **acid**?

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

Water makes the acid disappear.

Water lets the acid dissolve and produce H^+ (aq) ions.

Water lets the acid dissolve and produce OH^- (aq) ions.

Water makes the acid more concentrated.

[1]

[Total: 2]

11 Bobby reacts small pieces of magnesium with acid. The reaction produces a gas.

Bobby collects the gas in an upturned container filled with water.

The gas displaces an equal volume of water from the container.

When all of the magnesium has reacted, 35 cm^3 of gas has been produced.

(a) Bobby has the following pieces of apparatus in the laboratory.

50 cm^3 beaker

100 cm^3 beaker

500 cm^3 beaker

25 cm^3 measuring cylinder

50 cm^3 measuring cylinder

100 cm^3 measuring cylinder

Which of these pieces of apparatus should Bobby have used to collect and measure the gas?

Explain your choice.

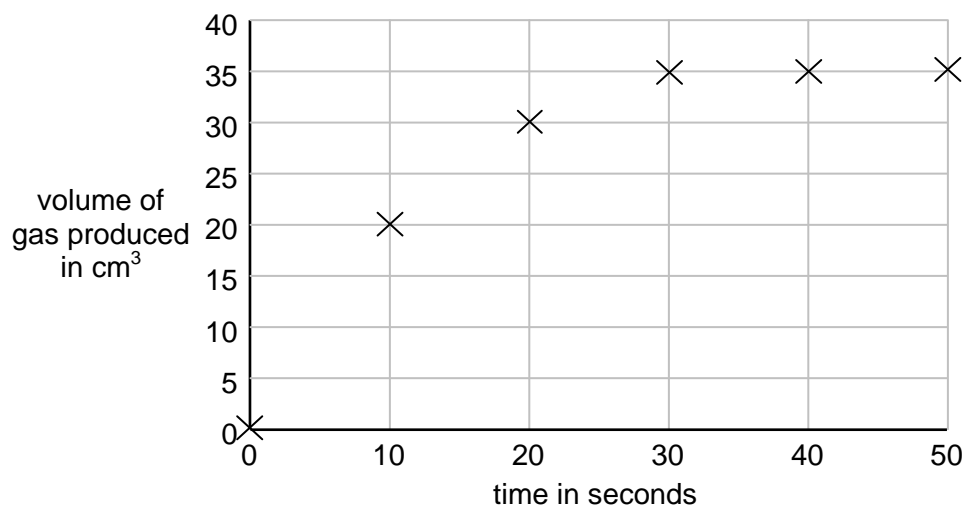
.....

.....

..... [2]

(b) Bobby measured the amount of gas given off every 10 seconds.

He plotted these data on a piece of graph paper.



(i) Complete the graph by drawing the line of best fit.

[1]

- (ii) Bobby calculates what the rate of reaction was at different times during the experiment. He does this by calculating how much gas was produced per second. Prove that the rate of reaction was fastest during the first ten seconds of the experiment.

[2]

- (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 10 s, in cm ³	volume of gas collected after 30 s, in cm ³	volume of gas collected after 50 s, 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.

.....

.....

.....

..... [3]

[Total: 8]

(b) The acid and alkali get slightly warmer as they react.

Put a ring around the correct name for this type of reaction.

electrolysis

endothermic

exothermic

thermal

[1]

[Total: 7]

[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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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						

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

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TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

A172/01

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

MARK SCHEME

MAXIMUM MARK 60

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 not 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.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth one mark.

Put ticks (✓) in the two correct boxes.

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

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 should be blank (or have indication of choice crossed out).

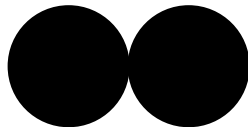
Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR


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	(a)	melting point decreases down the group	[1]	
	(b)	63°C	[1]	
	(c)	<p>Websites are always wrong. <input type="checkbox"/></p> <p>We can never be sure that any measurement tells us the true value. <input checked="" type="checkbox"/></p> <p>The apparatus used to take the measurements must have been faulty. <input type="checkbox"/></p> <p>If we make several measurements of any quantity, these are likely to vary. <input checked="" type="checkbox"/></p>	[2]	
Total			[4]	

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

Question		Expected answers	Mark	Additional guidance
3	(a)	1	[1]	
	(b)	(i) 7	[1]	
		(ii) the group number and the number of electrons in the outer shell of an atom are the same	[1]	
Total			[3]	

Question		Expected answers	Mark	Additional guidance
4	(a)		[1]	
	(b)	(i) sodium + chlorine → sodium chloride equation shown fully correct	[1]	
		(ii) <u>orange gas</u> at start and <u>white solid</u> at end reaction takes 8-12 s / slower than iodine but faster than chlorine	[2]	

Question		Expected answers	Mark	Additional guidance
4	(c) 	<p>[Level 3] Answer clearly compares all relevant properties of the two chemicals and how these properties impact on safe use, and indicates a clear choice logically linked to this comparison. 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)</p> <p>[Level 2] Answer compares some of the properties of the two chemicals and how these properties impact on safe use, and indicates a choice. 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)</p> <p>[Level 1] Answer compares one property of the chemicals and indicates a choice OR answer compares one or more of the properties but does not reach a conclusion. 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)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <p><i>Comparison of states/boiling points:</i></p> <ul style="list-style-type: none"> chlorine will be a gas (at room temperature/pressure) so chlorine may be (more) difficult to contain/use need to be used in a fume cupboard escape/be inhaled bromine, will be a liquid (at room temperature/pressure) / has a higher boiling point so bromine may be easier to contain/use be used without a fume cupboard be spilt on skin/clothes <p><i>Comparison of hazards:</i></p> <ul style="list-style-type: none"> both are toxic bromine is also corrosive <p><i>Comparison of reactivity:</i></p> <ul style="list-style-type: none"> bromine is less reactive <p>ignore references to both of the chemicals being halogens</p>
		Total	[10]	

Question		Expected answers	Mark	Additional guidance
5	(a) 	<p>[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)</p> <p>[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)</p> <p>[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)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> 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

Question	Expected answers	Mark	Additional guidance
(b)		[2]	All correct = 2 1 correct = 1
Total		[8]	

Question		Expected answers	Mark	Additional guidance
6	(a)	4	[1]	
	(b)	Formula mass of $\text{Cu}_2\text{O} = 63.5 + 63.5 + 16 = 143$ $\frac{63.5 + 63.5}{143} \times 100 = 88.8$	[2]	accept any answer correctly rounded from 88.81118881
	(c)	the mined rock will contain other minerals/impurities	[1]	reject suggestions that the extraction or mining procedure will not recover all of the copper
	(d)	heat the cuprite with carbon	[1]	accept 'reduce the cuprite' without practical details
Total			[5]	


Question		Expected answers	Mark	Additional guidance
7	(a)	D	[1]	
	(b)	<p>...conducts electricity when it is a solid.</p> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	[1]	
	(c)	B	[1]	
Total			[3]	

Question		Expected answers	Mark	Additional guidance
8	(a)	diamond has a giant covalent structure with no free moving electrons but graphite has layers with mobile electrons between them	[2]	for full marks the type of bond must be linked to the availability of electrons
	(b)	graphite is soft so leaves marks on paper	[1]	
Total			[3]	




Question		Expected answers	Marks	Additional guidance
9	(a)		[2]	3 lines correct = 2 1 or 2 lines correct = 1
	(b)	<p>filter the contents of the flask / pour through filter paper then crystallise the salt by evaporating the water and finally dry the crystals in an oven/desiccator</p>	[3]	for full marks the explanation must be expressed in a logical and coherent order
		Total	[5]	

Question		Expected answers	Marks	Additional guidance
10	(a)	citric acid	[1]	
	(b)	<p>lets the acid dissolve and produce H⁺ (aq) ions.</p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	[1]	
Total			[2]	

Question		Expected answers	Marks	Additional guidance
11	(a)	he should use the 50 cm ³ measuring cylinder because it is big enough to hold 35 cm ³ of gas but will be more accurate than the 100 cm ³ cylinder and all of the beakers	[2]	for full marks the explanation must link the choice of apparatus to accuracy of measurement
	(b) (i)	<p>volume of gas produced in cm³</p> <p>time in seconds</p>	[1]	the line of best fit should be a smooth curve that passes within 2 mm of each point reject straight lines drawn between points before 30 seconds
	(ii)	<p>rate between 0 and 10 s = $20 \div 10 = 2 \text{ cm}^3/\text{s}$</p> <p>rate between 10 and 20 s = $10 \div 10 = 1 \text{ cm}^3/\text{s}$</p> <p>rate between 20 and 30 s = $5 \div 10 = 0.5 \text{ cm}^3/\text{s}$</p> <p>rate between 30 and 50 s = 0</p>	[2]	<p>units are not required for the marks, but if units are given they must be correct</p> <p>if no calculations are shown, credit "the line is steepest between 0 and 10 s" for 1 mark max.</p>
	(c)	<p>experiment A</p> <p>because a larger mass of magnesium pieces will give a higher rate of reaction, so more gas will have been produced by 10s</p> <p>and a larger mass of reactant will produce a greater volume of product/gas/hydrogen</p>	[3]	for full marks the explanation must be expressed in a logical and coherent order
Total			[8]	

Question		Expected answers	Marks	Additional guidance
12	(a) 	<p>[Level 3] Discusses all the major stages in the titration, including the measurements to be taken. 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)</p> <p>[Level 2] Aspects are missing, but the candidate is clearly familiar with titration as a procedure and raises at least one aspect which affects the accuracy. 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)</p> <p>[Level 1] There is some evidence that the candidate recognises a titration as a procedure. 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)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> • put the acid in the burette • add an indicator to the alkali in the flask • take the burette reading before you start adding the acid • add the acid in small amounts at a time • as you approach the rough titration add the acid more slowly and swirl the flask between each addition • stop adding the acid when you see the first permanent colour change • take the burette reading at the end
	(b)	exothermic	[1]	
Total			[7]	

Assessment Objectives (AO) Grid
(includes quality of written communication )

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