OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

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	

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 **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 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 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.

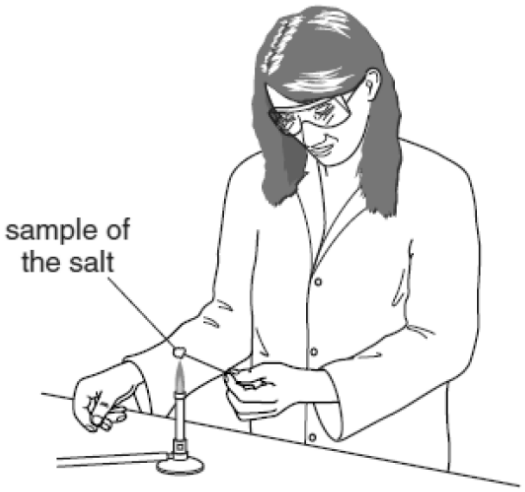
Put ticks (✓) in the boxes next to the **two** statements that explain this.

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]

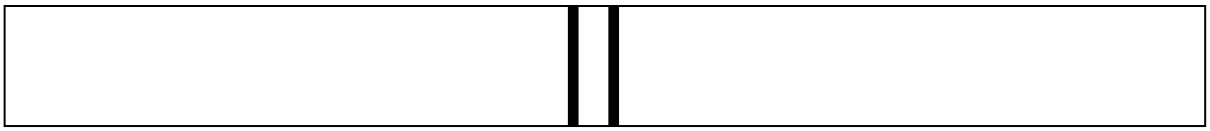
2 Eve tests some salts by doing a flame test.



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.

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.....

.....

..... **[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]

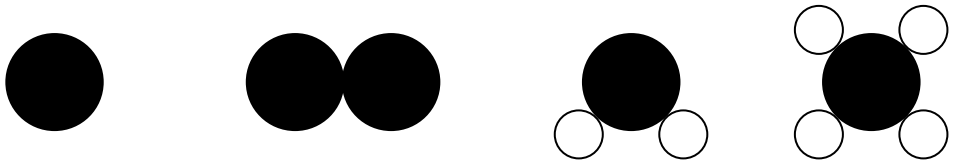
4 This question is about the Group 7 elements, known as the halogens.

(a) The symbol for a bromine molecule is

$$Br_2$$

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]**

(c) Alex makes some cards to show the properties of chlorine and bromine.

Chlorine

State: gas at room temperature and pressure
Boiling point: -35 °C
Hazard: Toxic
Notes:
Chlorine is a halogen. It is the **second** most reactive element in Group 7.

Bromine

State: liquid at room temperature and pressure
Boiling point: 59 °C
Hazard: Toxic and corrosive.
Notes:
Bromine is a halogen. It is the **third** most reactive element in Group 7.

Alex wants to use either chlorine or bromine in an experiment at school.

She wants to choose the safest chemical.

Discuss which of these chemicals Alex should choose. Give reasons for your choice.

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

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

[Total: 10]

5 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

(a) 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]**

(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.

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.

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..... **[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.

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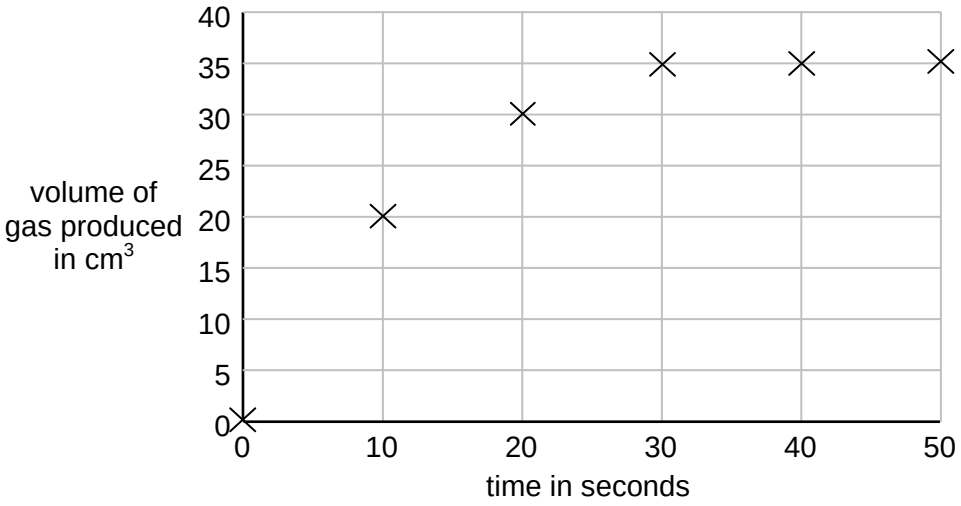
.....

..... **[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.

.....

.....

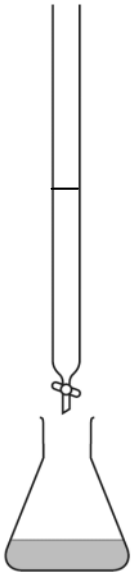
.....

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

[Total: 8]

12 Mary carries out an acid / alkali titration.

She puts 25.0 cm^3 of alkali solution in a conical flask and does a rough titration.



Mary then does an accurate titration.

(a) What are the main stages in carrying out an accurate titration? Include any readings Mary should take.

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

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

(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

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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GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A **A172/01**

Unit A172: Modules C4, C5, C6 (Foundation 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

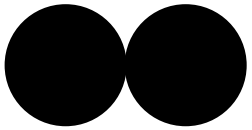
10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- 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	(a)		melting point decreases down the group	[1]	
	(b)		63°C	[1]	
	(c)		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]	

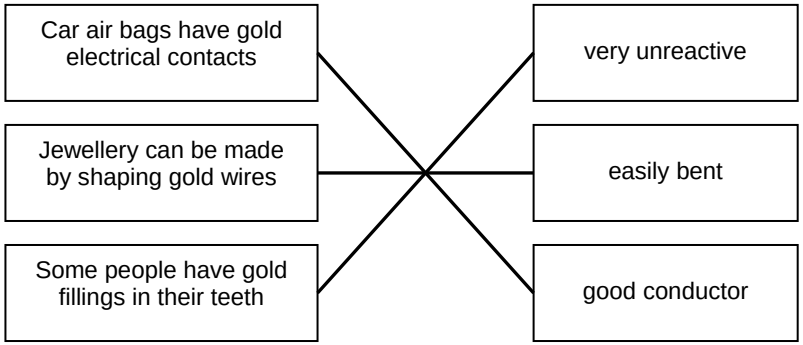
Question			Expected answers	Mark	Additional guidance
2			the similarity is that they will both have lines the difference is that the lines will be different colours / the lines will be in different places / the lines will be in a different pattern	[2]	
			Total	[2]	

Question			Expected answers	Mark	Additional guidance
3	(a)		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)	orange gas at start and white solid at end reaction takes 8-12 s / slower than iodine but faster than chlorine	[2]	

Question			Expected answers	Mark	Additional guidance
4	(c)		**[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) **[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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** *Comparison of states/boiling points:* • chlorine will be a gas (at room temperature/pressure) • so chlorine may be (more) difficult to contain/use need to 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 *Comparison of hazards:* • both are toxic • bromine is also corrosive *Comparison of reactivity:* • bromine is less reactive **ignore** references to both of the chemicals being halogens
			Total	**[10]**	

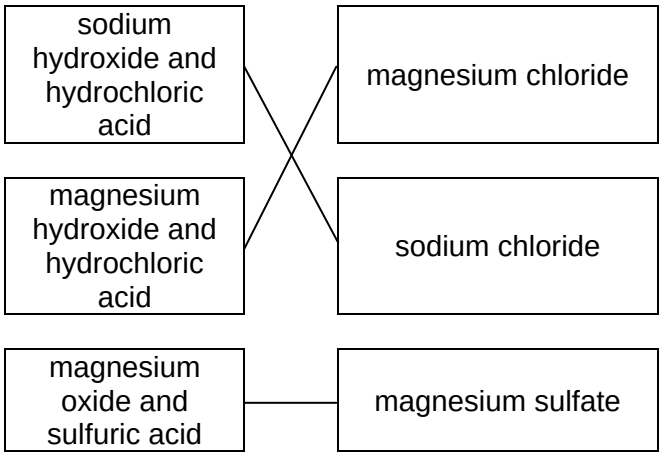
Question			Expected answers	Mark	Additional guidance
5	(a)		**[Level 3]** Chooses aluminium and uses its properties to explain suitability. Uses properties of other metals to explain their lack of suitability. Refers to compromise of properties for purpose. All information in the answer is relevant, 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

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

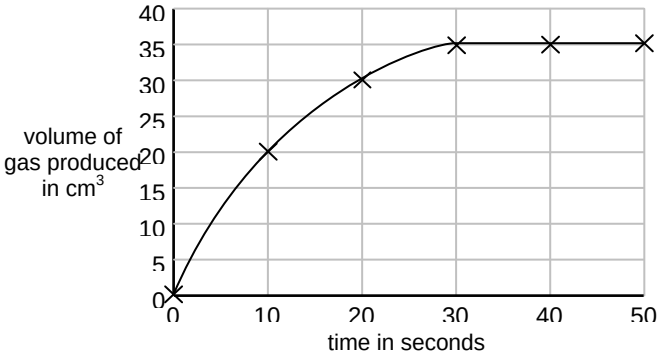
Question			Expected answers	Mark	Additional guidance
6	(a)		4	[1]	
	(b)		Formula mass of Cu_2O = 63.5 + 63.5 + 16 = 143 $\frac{63.5 + 63.5}{143} \times 100 = 88.8$	[2]	**accept** any answer correctly rounded from 88.81118881
	(c)		the mined rock will contain other minerals/impurities	[1]	**reject** suggestions 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)		…conducts electricity when it is a solid. ☐ ☐ ✓ ☐	**[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)		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	[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)		lets the acid dissolve and produce H^+ (aq) ions. ✓	**[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)		[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)	rate between 0 and 10 s = 20 ÷ 10 = 2 cm^3/s rate between 10 and 20 s = 10 ÷ 10 = 1 cm^3/s rate between 20 and 30 s = 5 ÷ 10 = 0.5 cm^3/s rate between 30 and 50 s = 0	[2]	units are not required for the marks, but if units are given they must be correct if no calculations are shown, **credit** "the line is steepest between 0 and 10 s" for 1 mark max.
	(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
			Total	[8]	

Question			Expected answers	Marks	Additional guidance
12	(a)		**[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) **[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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • 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**