OCR
Oxford Cambridge and RSA

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Tuesday 7 November 2017 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A/ADDITIONAL SCIENCE A

A172/01 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, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.
- The Periodic Table is printed on the back page.
- A list of qualitative tests for ions is printed on page 2.

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

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Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 The properties of Group 1 metals change down the group.

(a) The table shows information about some Group 1 metals.

Group 1 metal	Melting point in °C	Boiling point in °C
lithium	181	1342
sodium	98	883
potassium	63	759

(i) How do the melting points and boiling points change down Group 1?

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

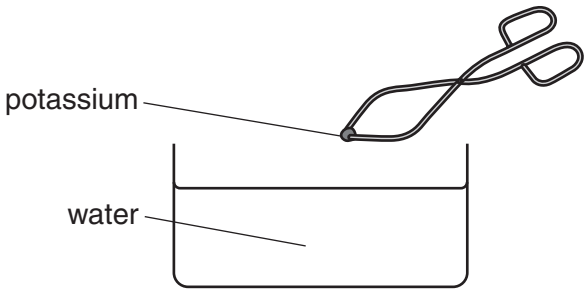
(ii) Rubidium comes below potassium in Group 1.

Rubidium is a solid at room temperature (20 °C).

Predict the melting point and boiling point of rubidium.

melting point ..... °C boiling point .....°C
[2]

(b) Potassium reacts with water.



(i) What do you **see** when potassium reacts with water?

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

(ii) The reaction makes potassium hydroxide.

What is the formula for potassium hydroxide?

Put a (ring) around the correct answer.

KOH **KH_2** **K_2O** **PO** **[1]**

(c) Potassium is flammable.

(i) Which hazard symbol shows that a chemical is flammable?

Put a (ring) around the correct answer.

[1]

(ii) What safety precautions should be taken when using potassium?

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

[Total: 9]

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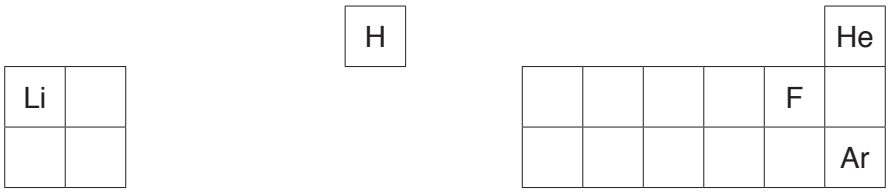
2 Helium is an element. It has the symbol He.

(a) The diagram shows part of the Periodic Table.



(i) Which element is likely to have similar properties to helium?

Put a ring around the correct answer.

Ar **F** **H** **Li** **[1]**

(ii) Which element is in the same period as helium?

Put a ring around the correct answer.

Ar **F** **H** **Li** **[1]**

(iii) The proton number of helium is 2.

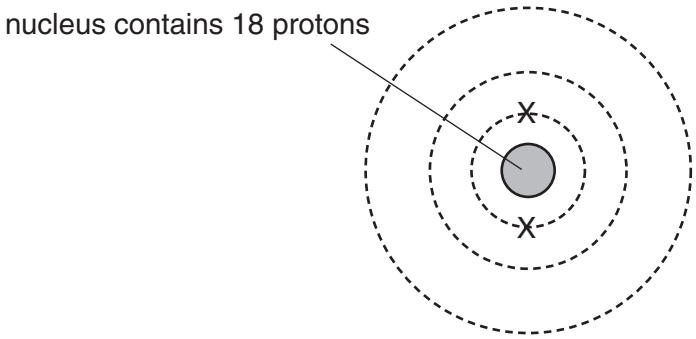
Which element has a proton number of 3?

Put a ring around the correct answer.

Ar **F** **H** **Li** **[1]**

(iv) The diagram shows part of the structure of an argon atom.

Complete the diagram to show the arrangement of the rest of the electrons in an argon atom.



[2]

(b) Helium was discovered when scientists noticed lines in the spectrum of light from the Sun.

Janssen and Lockyer were two scientists who collected **evidence** and suggested **ideas** about helium.

Janssen, August 1868

EVIDENCE: Scientists already know that the spectrum of sodium has lines in the yellow part of the spectrum like this.

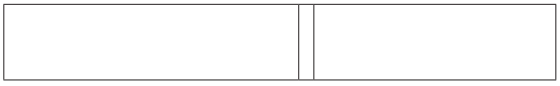
I have looked at this part of the spectrum from the Sun. It looks similar to the spectrum of sodium. It has lines like this. They are all close together in the yellow part of the spectrum.

JANSSEN'S IDEA: I think that I have found a new line in the spectrum of sodium.

Lockyer, October 1868

EVIDENCE: I have checked Janssen's work. I have found that the yellow part of the Sun's spectrum has lines like this.

I have checked the spectrum from pure sodium in the laboratory. The spectrum from the pure sodium only has lines in the yellow part of the spectrum like this.



LOCKYER'S IDEA: I think that this shows that there must be another element in the Sun. I am going to call this new element 'helium'.

The two scientists collected evidence and suggested ideas.

Use the information to show:

- the similarities and differences between the two scientists' work
- how the evidence supports each of the scientist's ideas.

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

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

[Total: 11]

3 Silver-coloured coins contain a mixture of copper and nickel.

(a) Copper for making coins can be extracted from different copper compounds.

The table shows information about the copper compounds, **A**, **B**, **C** and **D**.

Compound	Formula of copper compound	Atoms in the formula	Relative formula mass of compound
A	**CuO**	1 copper atom 1 oxygen atom	63.5 + 16 = 79.5
B	**.....**	1 copper atom 1 sulfur atom	95.5
C	**$CuFeS_2$**	....	183.5
D	**$CuCl_2$**	1 copper atom 2 chlorine atoms	.....

(i) Complete the table by filling in the boxes.

Use these relative atomic masses to help you.

Atom	Relative atomic mass
copper	63.5
iron	56
sulfur	32
oxygen	16
chlorine	35.5

[3]

(ii) Mineral **A** contains copper oxide.

Copper metal is extracted from copper oxide in a reduction reaction.

What happens in a reduction reaction?

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

(b) A mining company wants to build a new nickel mine.

The company looks at some different sites for the mine. All of the sites have ore deposits of similar size.

The table shows information about the sites.

Site number	Percentage of nickel in ore	Area where ore is found	Other information
1	1.0	50 m under the ground	limited roads nearby, no local towns
2	2.2	on the deep sea floor	large sea port and town nearby
3	1.8	near an earthquake zone	road and sea transport nearby, town nearby
4	2.2	300 m under the ground	road and sea transport nearby, town nearby

The company decides that site 4 is the best choice because it is likely to have the lowest overall cost of extracting nickel.

Explain why the **cost** of extracting nickel is likely to be higher at each of the other sites than at site 4.

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

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

[Total: 10]

4 Aluminium is a metal that is used for overhead electricity cables and cooking foil.

The table shows some information about the properties of aluminium.

Melting point	660 °C
Density compared to other metals	low
Electrical conductivity	very high
Heat conductivity	very high
Other properties	not magnetic

(a) Which **two** properties of aluminium are important for overhead electricity cables?

Choose properties from the table.

1 .....

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

(b) Which **two** properties of aluminium are important for cooking foil?

Choose properties from the table.

1 .....

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

(c) Aluminium can be worked into different shapes easily.

Which word describes this property?

Put a (ring) around the correct answer.

hard **malleable** **shiny** **strong** **[1]**

(d) Aluminium is extracted by the electrolysis of aluminium oxide.

Aluminium oxide is an ionic compound.

It has to be melted to make the electrolysis work.

(i) What happens when aluminium oxide melts?

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

an exothermic reaction begins	☐
the process makes water	☐
crystals form	☐
the ions start to move around	☐

[1]

(ii) The final products of the extraction are solid aluminium metal and oxygen gas.

Draw straight lines to link each **product** to its correct **formula** and its correct **state symbol**.

formula	**product**	state symbol
Al		
A		(s)
	solid aluminium metal	
ALU		(l)
O		(g)
	oxygen gas	
O_2		(aq)
2O		

[2]

(e) Most other metals can be extracted by heating their oxides with carbon.

It is **not** possible to extract aluminium by heating aluminium oxide with carbon.

Explain why.

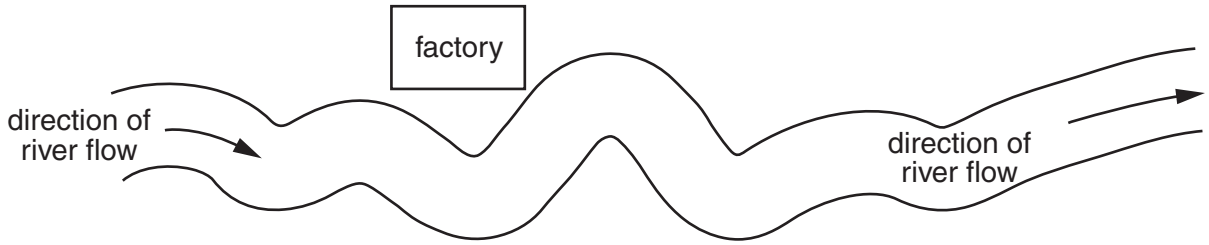
..... **[1]**

[Total: 9]

5 Zak works for a company that makes salts.

The company has a factory beside a river.

Part of Zak's job is to check that the factory does not affect the pH of the water in the river.



(a) Zak measures the pH of the water from the river **before** it flows past the factory.

Explain why he does this.

.....

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

(b) Zak plans to take other samples of water from the river to find out if the factory affects the pH of the river.

What should Zak consider when planning to take more samples?

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.....

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

(c) What could Zak use to test the pH of a sample of water?

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

pH meter	☐
dilute sodium chloride	☐
litmus paper	☐
universal indicator solution	☐
dilute potassium hydroxide	☐

[1]

(d) Zak finds that all of the water samples are slightly acidic.

Put a tick (✓) in the box next to the best explanation for this.

A substance in the water produces H^+ ions.	☐
A substance in the water produces OH^- ions.	☐
A substance in the water produces H^- ions.	☐
A substance in the water produces OH^+ ions.	☐
There are too many negative ions in the water.	☐

[1]

(e) Some of the salts that the factory makes are sulfates.

Zak wants to test the water samples to find out if they contain sulfate ions.

Describe the test and result for sulfate ions.

Use the Data Sheet on page 2 to help you.

test: .....

.....

result: .....

.....

[2]

[Total: 7]

6 A company makes bath crystals.

People like to put bath crystals into their bathwater.

(a) The company makes large, dry crystals from solutions of salts dissolved in water.

Describe how to make large, dry crystals from a solution that contains salts.

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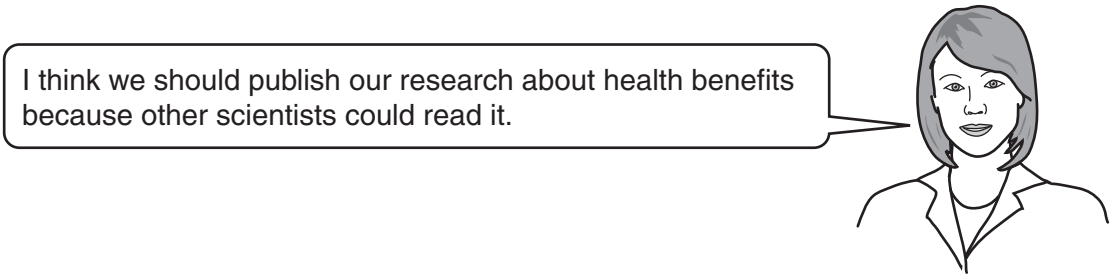
..... **[3]**

(b) A team of scientists researches the health benefits of using salts in bathwater.

They find that the salts help to relieve some aches and pains.

This is what one of the scientists says:



Why do scientists publish their research for other scientists to read?

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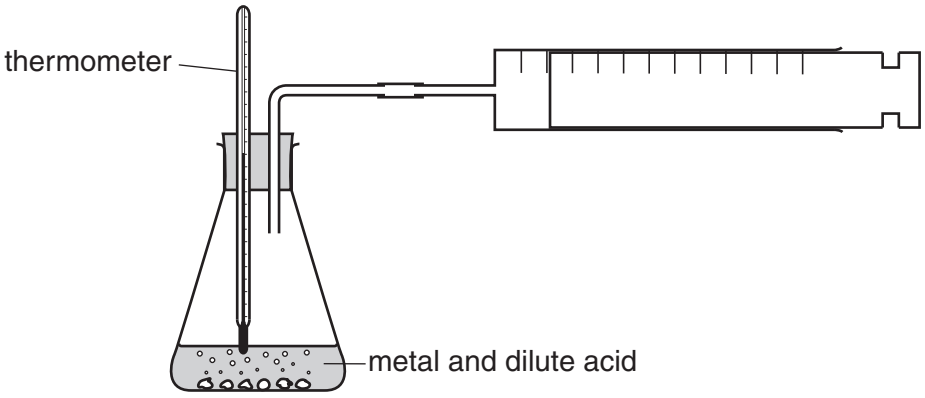
..... **[2]**

[Total: 5]

7 Eve investigates the rate of reaction when a metal reacts with dilute acid.



(a) Eve makes sure that the test is fair by using metal pieces of the same size in each experiment.

Explain why the results change if she uses different sized pieces of metal.

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

(b) What is the name of the gas that is made when a metal reacts with an acid?

Put a (ring) around the correct answer.

carbon dioxide **hydrogen** **methane** **nitrogen** **oxygen** **[1]**

(c) Eve does more experiments using five different metals.
In each experiment she reacts a metal with dilute hydrochloric acid.
She records the time taken to make 10 cm^3 gas.
She also measures the temperature change.

The table shows Eve's results.

Metal	Time taken to make 10 cm^3 gas in seconds	Temperature increase during reaction in °C
zinc	11	4
magnesium	8	5
copper	no gas made	0
iron	16	2
calcium	6	8

Use Eve's results to put the metals in order of reactivity. Explain how you used all of the data in the table to make your decisions.

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

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

[Total: 9]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.