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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 numb	er		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

lon	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

lon	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

3 BLANK PAGE

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

	1		
	(i)	How do the melting points and boiling points change down Group 1?	[4]
	(ii)	Rubidium comes below potassium in Group 1.	[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)	Pot	tassium reacts with water.	
		potassium water	
	(i)	What do you see when potassium reacts with water?	
	(ii)	The reaction makes potassium hydroxide.	
		What is the formula for potassium hydroxide?	
		Put a (ring) around the correct answer.	
		KOH KH ₂ K ₂ O PO	[1]

- (c) Potassium is flammable.
 - (i) Which hazard symbol shows that a chemical is flammable? Put a (ring) around the correct answer.









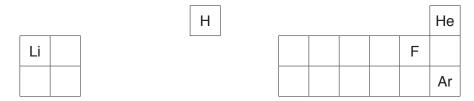
What safety precautions should be taken when using potassium?
[2]

[Total: 9]

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PLEASE DO NOT WRITE ON THIS PAGE

- 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.

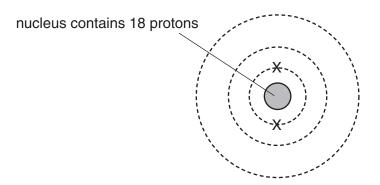
Which element has a proton number of 3?

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	e quality of written co	ommunication will b	oe assessed in your a	answer.
				[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
Α	CuO	1 copper atom 1 oxygen atom	63.5 + 16 = 79.5
В		1 copper atom 1 sulfur atom	95.5
С	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	
CC	ontains copper oxid	de.	

[3]

(ii) Mineral A co

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

What happens in a reduction reaction?

.....[1]

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(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.
[6]
[0]

[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

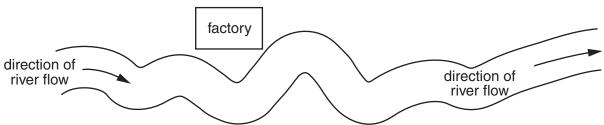
	hard malleable shiny strong [1	ij
	Put a round the correct answer.	
	Which word describes this property?	
(c)	Aluminium can be worked into different shapes easily.	
	2[2	2]
	1	
	Choose properties from the table.	
(b)	Which two properties of aluminium are important for cooking foil?	
	2[2	2]
	1	
	Choose properties from the table.	
(a)	Which two properties of aluminium are important for overhead electricity cables?	

(d)	Alur	minium	n is extracted by the	ne electrolysis of a	luminium oxide.		
	Alur	minium	oxide is an ionic	compound.			
	It ha	as to b	e melted to make	the electrolysis wo	ork.		
	(i)	What	happens when a	luminium oxide me	elts?		
		Put a	tick (🗸) in the box	x next to the correc	ct answer.		
		a	an exothermic rea	ction begins			
		t	he process make	s water			
		C	crystals form				
		t	he ions start to m	ove around			
							[1]
	(ii)	The fi	inal products of th	e extraction are so	olid aluminium metal and	l oxygen gas.	
		Draw symb		link each produc	t to its correct formula	a and its correct	state
г	fori	mula	1	product		state symbol	
	-	A <i>l</i>					
		A				(s)	
			1	solid aluminium	metal		
	A	LU				(1)	
		0				(g)	
ſ]	oxygen gas	3		
		02				(aq)	
	2	20					[2]
(e)	Mos	st othe	r metals can be e	xtracted by heating	g their oxides with carbo	n.	[2]
	It is	not po	ossible to extract	aluminium by heati	ing aluminium oxide with	n carbon.	
	Ехр	lain wl	ny.				
							[1]
						[Tot	tal: 9]

Zak works for a company that makes salts. 5

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	n the river before it flows past the factory.
	Explain why he does this.	
		[1]
(b)	Zak plans to take other samples of wa of the river.	ter from the river to find out if the factory affects the pH
	What should Zak consider when plann	ing to take more samples?
		[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	[11]

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[1]

	「Tot	al: 7]
		[2]
	result:	
	test:	
	Use the Data Sheet on page 2 to help you.	
	Describe the test and result for sulfate ions.	
	Zak wants to test the water samples to find out if they contain sulfate ions.	
(e)	Some of the salts that the factory makes are sulfates.	
	There are too many negative ions in the water.	[1]
	A substance in the water produces OH+ ions.	
	A substance in the water produces H ⁻ ions.	
	A substance in the water produces OH ⁻ ions.	
	A substance in the water produces H ⁺ ions.	
	Put a tick (✓) in the box next to the best explanation for this.	
(d)	Zak finds that all of the water samples are slightly acidic.	

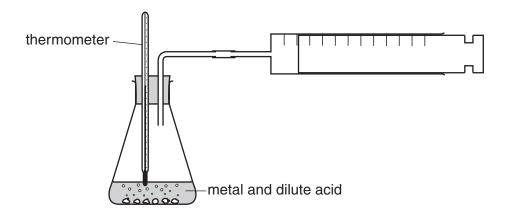
6

A c	ompany makes bath crystals.
Ped	ople 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.
	[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:
	I think we should publish our research about health benefits because other scientists could read it.
	Why do scientists publish their research for other scientists to read?

[Total: 5]

.....[2]

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



	[2]
	Explain why the results change if she uses different sized pieces of metal.
(a)	Eve makes sure that the test is fair by using metal pieces of the same size in each experiment.

(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 cm³ 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.
[6]
[Total: 9]

END OF QUESTION PAPER



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The Periodic Table of the Elements

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111
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* 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.