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F

Monday 25 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

A172/01 Modules C4 C5 C6 (Foundation Tier)

A135360612

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

A172012

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 bar codes.

INFORMATION FOR CANDIDATES

- Your 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 **24** 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

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Answer **all** the questions.

1 Joe watches a DVD that shows how some Group 7 elements react with iron.

Joe makes some notes about what he sees.

fluorine F	Most reactive element in the group. Explosive reaction with iron.
chlorine C*l*	Very bright flame, iron burns away quickly.
bromine Br	Less bright flame, takes longer for reaction with iron to finish.
iodine I	
astatine At	

(a) What do Joe's notes show about the **trend** in reactivity down Group 7?

.....

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

(b) The presenter on the DVD talks about the results of the experiments.

Presenter
These results are useful because we can use them to make predictions about the reactivity of iodine and astatine in Group 7.

(i) Use Joe's notes to predict the reactivity of iodine and astatine.

.....

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

(ii) Joe writes this in his notes.

> I think that these results show that the **top element in every group** in the Periodic Table is the **most reactive**.

Do you agree with Joe? Explain your answer.

.....

.....

.....

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

[Total: 5]

2 The table shows data about the physical properties of some elements.

Element	Appearance at room temperature	Melting point in °C	Boiling point in °C	Does the element conduct electricity?
Chlorine	green gas	–101	–34	no
Bromine	red-brown liquid	–7	59	no
Iodine	dark grey solid	114	184	no
Lithium	shiny solid	180	1342	yes
Sodium	shiny solid	97.8	883	yes
Potassium	shiny solid	63.5	759	yes

Mendeleev put these elements into two groups in the Periodic Table.

He used their similarities and differences to put lithium, sodium and potassium in one group.

He put chlorine, bromine and iodine into another group.

Discuss which data in the table **support**, and which data **do not support**, Mendeleev's idea of organising these elements into the two groups.

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

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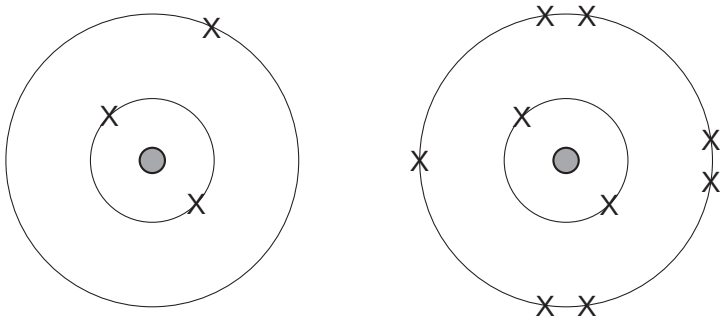
..... **[6]**

[Total: 6]

3 The diagram shows the arrangement of electrons in an atom of lithium and an atom of fluorine.



lithium **fluorine**

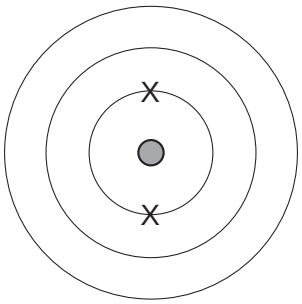
(a) The electron arrangement of the lithium atom is 2.1.

What is the electron arrangement of the fluorine atom?

electron arrangement = ... **[1]**

(b) Sodium has eleven electrons.

Complete the diagram to show the arrangement of all of the electrons in a sodium atom.



sodium

[1]

(c) Another element is in the same group of the Periodic Table as fluorine.

It has the electron arrangement 2.8.7.

What is the name of this element?

Use the Periodic Table to help you.

name of element ..... **[1]**

(d) Give the names of the two particles found in the nucleus of an atom.

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

[Total: 4]

4 Eve does an experiment with chlorine.

(a) She reacts chlorine with a metal. The reaction makes sodium chloride.

(i) Write a word equation for the reaction.

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

(ii) Before Eve does her experiment, she looks at the hazard warning sign for chlorine gas.

Eve needs to use safety precautions when she uses chlorine in her experiment.

Describe these safety precautions and explain why they are necessary.

.....

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

(b) Sea salt contains both sodium chloride and potassium chloride.

Which of the following statements about potassium chloride are **true** and which are **false**?

Put a tick (✓) in the correct box for each statement.

	true	**false**
Potassium chloride gives a coloured flame in a flame test.	☐	☐
Potassium chloride is a gas.	☐	☐
Potassium chloride can be made by reacting potassium with bromine.	☐	☐
Solid potassium chloride contains sodium ions and chloride ions.	☐	☐

[2]

[Total: 6]

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Question 5 begins on page 10

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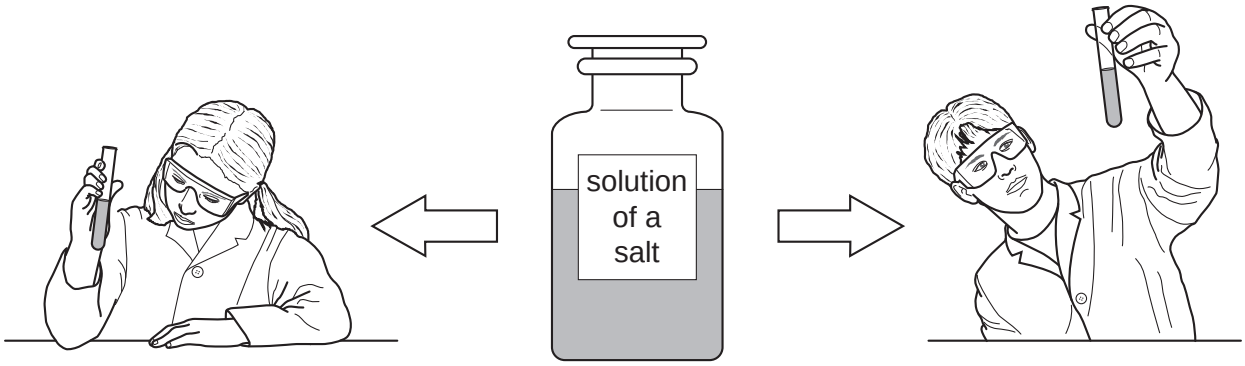
5 Amy and Zak test samples of the same solution of a salt.



Amy **Zak**

They do tests to identify the positive metal ions and the negative ions in the solution.

They use a fresh sample for each test.

They both use dilute sodium hydroxide and dilute silver nitrate to test the solution.

The boxes show the tests they use and their notes.

Amy's notes

Tests	Notes
Test 1 Add a few drops of dilute sodium hydroxide.	I think the solution contains **calcium** ions.
Test 2 Acidify and add dilute silver nitrate.	I think the solution contains **chloride** ions.

My conclusion

The solution contains **calcium chloride**.

Zak's notes

Tests	Notes
Test 1 Add a few drops of dilute sodium hydroxide… …then add more dilute sodium hydroxide.	I think the solution contains **zinc** ions.
Test 2 Acidify and add dilute silver nitrate.	I think the solution contains **chloride** ions.

My conclusion

The solution contains **zinc chloride**.

11

Amy and Zak both agree that the salt is a chloride but disagree about the metal ion in the salt.

Use the data sheet on page 2 to help you work out what Amy and Zak saw when they did the tests.

Explain how what they saw led them to their conclusions and who is more likely to be correct.

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

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

[Total: 6]

6 Massicot is a mineral. It contains lead oxide, PbO.

Lead metal is extracted from massicot. Lead is needed for roofing and car batteries.

Jed and Kay live near a lead mine.

(a) The mass of lead that can be extracted from massicot can be worked out using relative atomic masses.

(i) Use the Periodic Table to find the relative atomic masses of lead and oxygen.

relative atomic mass of lead = ...

relative atomic mass of oxygen = ... **[1]**

(ii) Use your answers to work out the relative formula mass of lead oxide, PbO.

relative formula mass of PbO = ...**[1]**

(b) The lead mine produces millions of tonnes of lead ore.

Jed and Kay are talking about the advantages and disadvantages of living near the lead mine.

Jed

The lead mine affects the surrounding area because they have to blast out 10 tonnes of rock to get less than a tonne of lead ore.

Kay

Yes, but the lead mine employs many local people.

(i) Kay has just moved into the area. She has a young family.

Give one **advantage** and one **disadvantage** to Kay of living near a lead mine.

.....

.....

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

(ii) Jed and Kay talk about lead processing at the mine.

Jed

Some waste from processing lead ore is toxic. I think we should close the mine until the process can be made completely safe.

Kay

I don't agree about closing the mine because ...

Suggest reasons that Kay could give for **not** closing the mine.

.....

.....

.....

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

[Total: 6]

7 Aluminium is extracted from its ore by electrolysis.

Aluminium ore contains aluminium oxide.

(a) This is the word equation for the reaction.

aluminium oxide $\longrightarrow$ aluminium + oxygen

The aluminium oxide is reduced.

What does this mean?

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

The aluminium oxide loses oxygen. ☐

The density of the aluminium oxide decreases. ☐

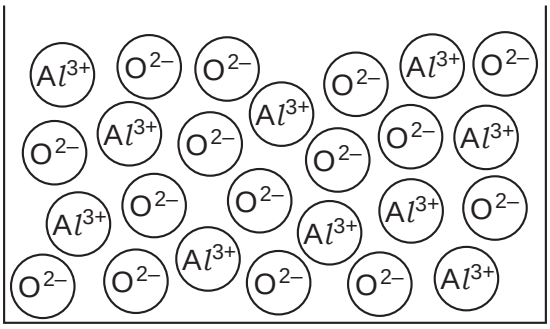
The aluminium oxide loses energy. ☐

The volume of the aluminium oxide decreases. ☐

[1]

(b) The electrolysis process uses molten aluminium oxide.

The diagram shows the arrangement of particles in molten aluminium oxide.



(i) Which two words can be used to describe molten aluminium oxide?

Put (rings) around the **two** correct answers.

covalent **gas** **ionic** **liquid** **molecular** **solid**

[2]

(ii) During the electrolysis, negative ions move to the positive electrode and positive ions move to the negative electrode. A product is made at each electrode.

Draw straight lines to connect each **electrode** with the correct **product made**.

electrode	product made
	aluminium
	aluminium oxide
positive electrode	
	water
negative electrode	
	hydrogen
	oxygen

[2]

(c) Aluminium has many different uses.

The uses of aluminium depend on making the best use of its properties.

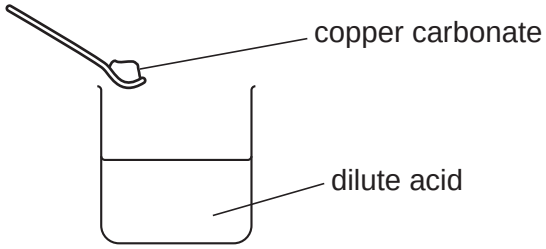
Draw four straight lines to connect each **use** with the **most important reason** for that use.

use	most important reason
aircraft parts	low density and can be mixed with other metals to make it strong
power cables	shiny appearance and surface can be coloured using dyes
drinks and food cans	surface is non-toxic and does not react with dilute acids
jewellery	very good electrical conductivity and can be shaped into wires

[2]

[Total: 7]

8 Sue reacts copper carbonate with a dilute acid to make copper chloride.



(a) Complete the word and symbol equations for the reaction by filling in the empty boxes.

copper carbonate + [ ] → copper chloride + carbon dioxide + [ ]

$CuCO_3$ + $2HCl$ → $CuCl_2$ + CO_2 + [ ]

[2]

(b) Which other chemicals react with the same dilute acid to form copper chloride?

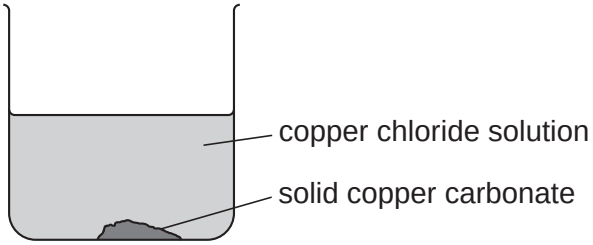
Put (rings) around the **two** correct answers.

copper hydroxide **copper nitrate** **copper oxide** **copper sulfate**

[1]

(c) Sue adds solid copper carbonate to the dilute acid until no more solid reacts.

At the end of the experiment, the beaker contains copper chloride solution and some left-over solid copper carbonate.



How can Sue make some **pure**, **dry** copper chloride **crystals** from the mixture in the beaker?

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

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

(d) Sue measures the mass of crystals that she has made (her actual yield).

Sue weighs an empty dish.

She puts her crystals into the dish and weighs it again.

These are her results.

mass of empty dish = 200.0 g
mass of dish and crystals = 204.5 g

(i) What is the mass of the crystals (the **actual yield**)?

mass = ... g **[1]**

(ii) The **theoretical yield** for Sue's experiment is 5.0 g.

Sue knows that

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

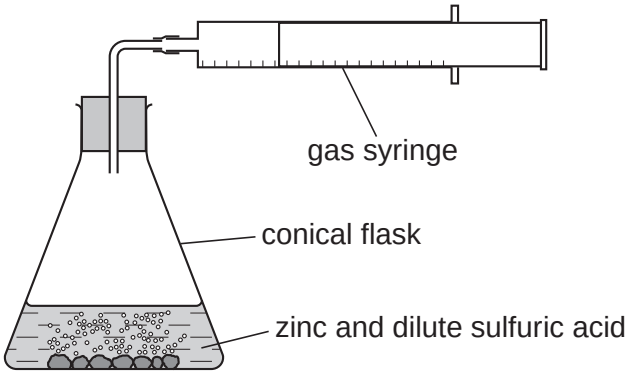
Use the actual yield from part **(i)** to calculate a percentage yield for Sue's experiment.

percentage yield = ... % **[1]**

[Total: 11]

9 Alex adds zinc to some dilute sulfuric acid.

He measures the volume of hydrogen gas given off every 30 seconds.



(a) Draw straight lines to connect each **chemical** to its correct **formula**.

chemical	**formula**
hydrogen	H_2SO_4
zinc	Zn
sulfuric acid	H_2

[2]

(b) What is the name of the salt that forms in the reaction between zinc and sulfuric acid?

Put a (ring) around the correct answer.

zinc chloride **zinc hydroxide** **zinc nitrate** **zinc oxide** **zinc sulfate**

[1]

(c) Alex thinks that the reaction is too slow.

He does not want to change the mass of the zinc.

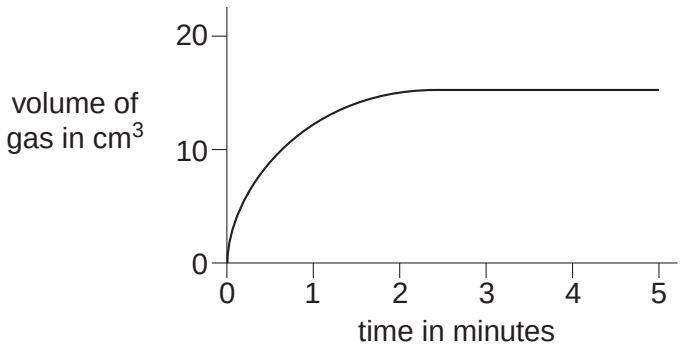
Suggest **two** ways that Alex could make the reaction faster.

.....

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

(d) Alex measures the volume of hydrogen in the gas syringe for 5 minutes.

He plots his results on a graph.



(i) Which statement is the best description of what is happening at the **start** of the reaction?

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

No reaction is happening. ☐

The reaction rate is at its fastest. ☐

The reaction is slow but getting faster. ☐

The reaction is happening at a constant rate. ☐

[1]

(ii) Which statement is the best description of what is happening after 5 minutes?

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

The reaction has stopped. ☐

The reaction rate is at its fastest. ☐

The reaction is increasing in rate. ☐

Gas is being given off at a constant rate. ☐

[1]

(e) Alex measures the pH of the contents of the flask at the start and at the end of the reaction.

The pH is very low at the start and increases during the reaction.

Why does the pH change in this way?

.....

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

[Total: 9]

END OF QUESTION PAPER

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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.