

Monday 10 June 2013 – Afternoon

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A172/02 Modules C4 C5 C6 (Higher 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

MODIFIED LANGUAGE



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 **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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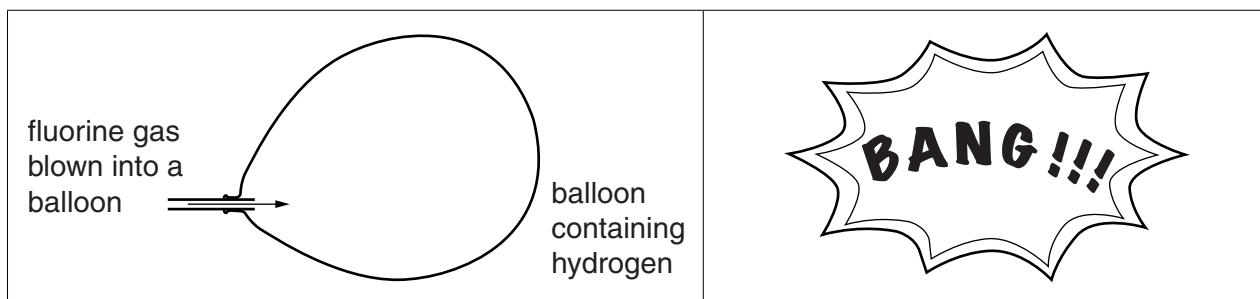
Question 1 begins on page 4

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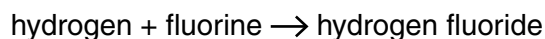
Answer **all** the questions.

- 1 Hydrogen reacts with the elements in Group 7 of the Periodic Table.

When hydrogen and fluorine are mixed together they explode.



The word equation for the reaction is



- (a) The formula for hydrogen fluoride is HF.

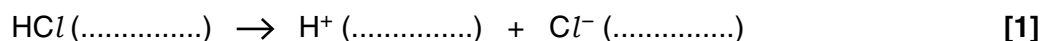
Write a balanced **symbol** equation for the reaction between hydrogen and fluorine.

..... [2]

- (b) Chlorine reacts with hydrogen to make hydrogen chloride gas (HCl).

When hydrogen chloride gas dissolves, it forms ions in the water.

- (i) Complete the symbol equation for the reaction by filling in the missing **state symbols**.



(ii) How does the equation show that the reaction produces an acid?

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

The reaction makes both positive and negative ions.

☐

One of the ions made is a hydrogen ion.

☐

Chloride ions are very acidic.

☐

A gas dissolves to make a solution.

☐

[1]

(c) Iodine is another element in Group 7.

Predict the **name** and the **formula** of the compound that is made when **iodine** reacts with hydrogen.

name

formula

[2]

(d) The table shows what happens when fluorine, chlorine and iodine react with hydrogen.

Element	Reaction when mixed with hydrogen
fluorine	explodes at room temperature
chlorine	a small spark can make the mixture explode
iodine	reacts slowly when heated strongly

(i) Describe the trend in reactivity of the Group 7 elements with hydrogen.

.....
 [1]

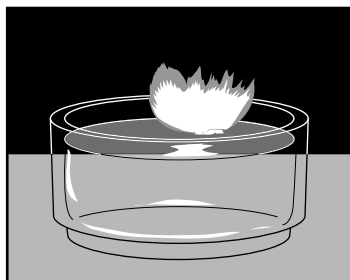
(ii) When bromine is heated it reacts steadily with hydrogen.
 Does this fit the trend of reactivity of the other halogens?
 Explain your reasoning.

.....
 [2]

[Total: 9]

- 2 Sodium and potassium are elements in Group 1 of the Periodic Table.

Jake watches a video of the reaction between sodium and water.



- (a) Complete the word equation for the reaction between sodium and water.

sodium + water \rightarrow + [2]

- (b) Jake thinks that the reaction makes an alkali.

How could you show that a solution has an alkaline pH?

.....

..... [2]

(c) Jake watches another video. This video shows the reaction of **potassium** with water.

How is this reaction different from the reaction of sodium with water?

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

The two reactions make different gases.

☐

The reaction of sodium takes less time than the reaction of potassium.

☐

The reaction with potassium makes an acid.

☐

The two reactions have different rates.

☐

The two reactions make different alkalis.

☐

[1]

[Total: 5]

He talks about his findings with other science students in an internet chat room.

Fay Lithium doesn't have a purple flame.

(a) Alex's ideas are that in flame tests:

- all the elements in a group of the Periodic Table have the same flame colour
- each group has its own flame colour.

Explain how each of the six pieces of evidence in the internet chat **supports** or **does not support** Alex's ideas.



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

..... [6

- (b) The students' internet chat is **not** an example of peer review.

Explain why.

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

[Total: 8]

Question 4 begins on page 10

4 Joe knows that 'hard' water contains dissolved calcium ions.

(a) Joe does some research about the concentration of calcium ions in 'hard' water.

Water	Concentration of calcium ions in mg/dm^3
very hard	>180
hard	121–180
moderately hard	61–120
soft	0–60

He also finds the concentration of calcium ions in water from different places.

Water	Concentration of calcium ions in mg/dm^3
water from Joe's town	200
water from Plymouth	40
water from London	160

What conclusions can Joe make from the data in the two tables?

.....

.....

.....

..... [4]

- (b) Joe does an experiment to find the **total mass** of dissolved solid in a sample of water from his local town.

He takes 50 cm^3 of the water and evaporates it to leave a solid.

He stores the solid in a desiccator and finds its mass a few days later.

- (i) Why is it important that he uses a desiccator?

Put ticks (✓) in the boxes next to the **two** best answers.

to keep the solid dry

☐

to keep the solid warm

☐

to make sure that the mass reading is accurate

☐

to allow ions in the solid to separate

☐

to neutralise the solid

☐

[2]

- (ii) The table shows Joe's results.

Volume of water in cm^3	Total mass of solid in g
50	0.02

Calculate the amount of solid in 1 dm^3 of water. Give your answer in g/dm^3 .

($1\text{ dm}^3 = 1000\text{ cm}^3$)

..... g/dm^3 [2]

- (iii) Use your answer to work out the number of **milligrams** (mg) of solid in 1 dm^3 of water.

($1\text{ g} = 1000\text{ mg}$)

..... mg/dm^3 [1]

(iv) Joe uses the same technique to analyse a sample of water from London.

He finds that the sample contains 450 mg/dm^3 of dissolved solid.

Joe's research found that London water contains 160 mg/dm^3 of calcium ions.

Why are the two values different?

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

Joe overheated the solid so that it decomposed.

☐

The water contained calcium and other ions.

☐

Joe used too small a volume of water in his experiment.

☐


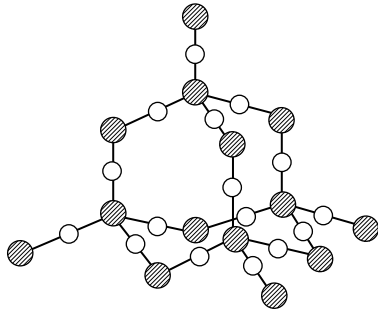
The relative atomic mass of calcium is higher than Joe realised.

☐

[1]

[Total: 10]

- 5 Carbon dioxide and silicon dioxide are compounds that occur naturally on Earth. The table shows some information about the two compounds.

	carbon dioxide	silicon dioxide
formula	CO_2	SiO_2
structure		
melting point in $^{\circ}\text{C}$	-78	1710
boiling point in $^{\circ}\text{C}$	-57	2230
electrical conductivity	does not conduct	does not conduct

- (a) Use ideas about structure and bonding to explain the similarities and differences between the properties of carbon dioxide and silicon dioxide.



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

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.....

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.....

.....

.....

..... [6]

(b) Where are carbon dioxide and silicon dioxide found?

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

They are both found in the atmosphere.

☐

Silicon dioxide is found only in the hydrosphere, carbon dioxide is found only in the lithosphere.

☐

Both carbon dioxide and silicon dioxide are found only in the lithosphere.

☐

Carbon dioxide is found in the atmosphere, silicon dioxide is found in the lithosphere.

☐

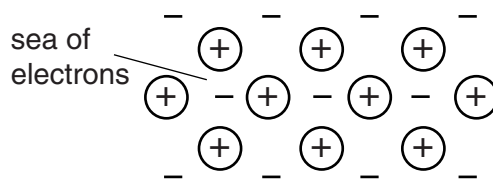
[1]

[Total: 7]

- 6 Aluminium is a metal with a low density and a high electrical conductivity.

Aluminium is used to make overhead power cables.

- (a) The diagram shows the bonding in a metal.



What does the symbol \oplus represent?

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

protons from metal atoms

☐

positively charged metal ions

☐

the nucleus of a metal atom

☐

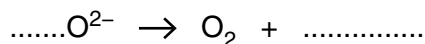
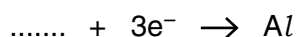
the positive metal electrode

☐

[1]

- (b) Aluminium is extracted by electrolysis of molten aluminium oxide.

Complete and balance the ionic equations to show what happens during the electrolysis of molten aluminium oxide.



[2]

- (c) Aluminium is a metal but aluminium oxide is an ionic compound.

Aluminium metal and molten aluminium oxide conduct electricity in different ways. Describe and explain the differences.

.....

.....

..... [3]

[Total: 6]

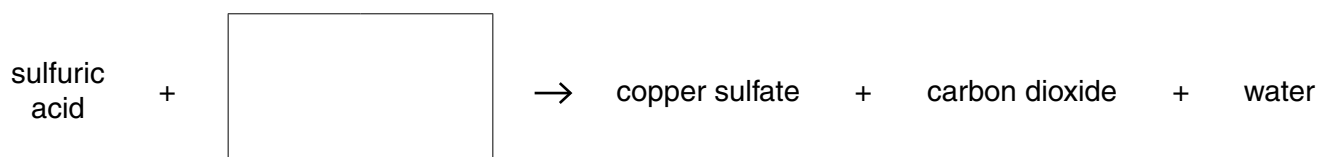
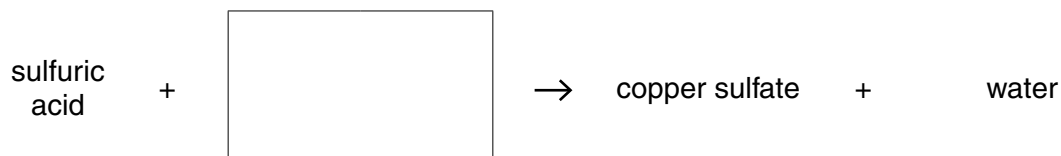
- 7 (a) Two different copper compounds react with sulfuric acid to make copper sulfate.

Complete the word equations.

Choose from this list.

copper carbonate copper chloride copper oxide

copper nitrate copper sulfate



[2]

- (b) Complete the table of information about copper compounds.

Name of compound	Formula of positive ion in compound	Formula of negative ion in compound	Formula of compound
copper chloride	Cu^{2+}	Cl^-	
copper sulfate	Cu^{2+}		CuSO_4
copper hydroxide	Cu^{2+}		$\text{Cu}(\text{OH})_2$

[2]

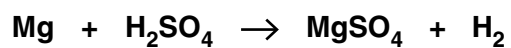
- (c) Eve reacts magnesium with sulfuric acid to make some magnesium sulfate.

She uses 2.4 g of magnesium.

She wants to work out the maximum mass of magnesium sulfate that she can make.

The equation for the reaction and part of Eve's calculation is shown below.

Complete the calculation.



Relative mass of Mg = 24 g

Mass of Mg used in experiment = 2.4 g

Mass of MgSO_4 made = g [2]

[Total: 6]

He dissolves each compound in water and measures the temperature change that happens when the compound dissolves.

Use the energy level diagrams to help you to explain the results Tom should expect from his experiment.



..... [6

(b) Draw straight lines to show the correct input and output variable in Tom's experiment.

	temperature
input variable	volume of water
output variable	solubility
	compound

[1]

(c) The energy changes for reactions in industry are carefully controlled. Why is this important?

Put ticks (✓) in the boxes next to the **two** best answers.

Energy given out by reactions can be used to heat buildings.

☐

Reactions that give out energy use too much fuel to keep them hot.

☐

Energy changes in reactions affect the rate.

☐

Containers for reactions may be damaged by extreme temperatures.

☐

Reactions that take in energy need to be continuously cooled.

☐

[2]

[Total: 9]

END OF QUESTION PAPER

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