

Candidate forename						Candidate surname					
Centre number						Candidate number					

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**A172/02**

**TWENTY FIRST CENTURY SCIENCE**  
**CHEMISTRY A**

**Modules C4 C5 C6 (Higher Tier)**

**MONDAY 25 JUNE 2012: Afternoon**

**DURATION: 1 hour**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

**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)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes on the first page. 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).

## **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.
- An enlarged copy of the Periodic Table will be provided.
- A list of qualitative tests for ions is printed on pages 4–5.

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# TWENTY FIRST CENTURY SCIENCE DATA SHEET

## QUALITATIVE ANALYSIS

### TESTS FOR IONS WITH A POSITIVE CHARGE

ION	TEST	OBSERVATION
calcium $\text{Ca}^{2+}$	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper $\text{Cu}^{2+}$	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) $\text{Fe}^{2+}$	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) $\text{Fe}^{3+}$	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc $\text{Zn}^{2+}$	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 $\text{CO}_3^{2-}$	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride $\text{Cl}^-$	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide $\text{Br}^-$	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide $\text{I}^-$	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate $\text{SO}_4^{2-}$	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

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**Answer ALL the questions.**

**1 Rubidium is an element in Group 1.**

**Find rubidium on the Periodic Table.**

**(a) Which of the following statements about rubidium are TRUE and which are FALSE?**

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

	<b>TRUE</b>	<b>FALSE</b>
<b>Rubidium is more reactive than sodium.</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Rubidium is a non-metal.</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Rubidium has a lower proton number than lithium.</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Rubidium reacts with water to make hydrogen gas.</b>	<input type="checkbox"/>	<input type="checkbox"/>

**[2]**

**(b) The formula of lithium hydroxide is LiOH.**

**What is the formula of rubidium hydroxide?**

**formula \_\_\_\_\_ [1]**

**[Total: 3]**

- 2 (a) The table below shows data about the physical properties of some elements.

<b>ELEMENT</b>	<b>APPEARANCE AT ROOM TEMPERATURE</b>	<b>MELTING POINT IN °C</b>	<b>BOILING POINT IN °C</b>	<b>DOES THE ELEMENT CONDUCT ELECTRICITY?</b>
<b>Chlorine</b>	<b>green gas</b>	<b>−101</b>	<b>−34</b>	<b>no</b>
<b>Bromine</b>	<b>red-brown liquid</b>	<b>−7</b>	<b>59</b>	<b>no</b>
<b>Iodine</b>	<b>dark grey solid</b>	<b>114</b>	<b>184</b>	<b>no</b>
<b>Lithium</b>	<b>shiny solid</b>	<b>180</b>	<b>1342</b>	<b>yes</b>
<b>Sodium</b>	<b>shiny solid</b>	<b>97.8</b>	<b>883</b>	<b>yes</b>
<b>Potassium</b>	<b>shiny solid</b>	<b>63.5</b>	<b>759</b>	<b>yes</b>

**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]**

**(b) Sodium and potassium are both in Group 1 of the Periodic Table.**

**Give one similarity and one difference between the arrangement of electrons in an atom of sodium and an atom of potassium.**

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**[2]**

**[Total: 8]**

**3 The table below shows the number of protons and electrons in five particles, A, B, C, D and E.**

**Each particle is either an atom or an ion.**

<b>PARTICLE</b>	<b>NUMBER OF PROTONS</b>	<b>NUMBER OF ELECTRONS</b>
<b>A</b>	<b>3</b>	<b>3</b>
<b>B</b>	<b>9</b>	<b>9</b>
<b>C</b>	<b>3</b>	<b>2</b>
<b>D</b>	<b>8</b>	<b>10</b>
<b>E</b>	<b>17</b>	<b>17</b>

**(a) Use the letters A, B, C, D and E, to answer the following questions.**

**(i) Which two particles are atoms from Group 7 of the Periodic Table?**

**answer \_\_\_\_\_ and \_\_\_\_\_ [1]**

**(ii) Which two particles are an atom and an ion of the same element?**

**answer \_\_\_\_\_ and \_\_\_\_\_ [1]**

**(iii) Which particle is a negative ion?**

**answer \_\_\_\_\_ [1]**

**(b) Particle C is an ion.**

**What is the overall charge on particle C?**

**answer \_\_\_\_\_ [1]**

**[Total: 4]**

**4 Liz cuts a piece of sodium with a knife.**

**(a) When first cut, the surface of the sodium is very shiny.**

**Describe and explain how the appearance of the sodium changes over the next few minutes.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

**(b) Liz reacts sodium (Na) with chlorine (Cl<sub>2</sub>) to make sodium chloride.**

**sodium + chlorine → sodium chloride**





**Write a balanced symbol equation for this reaction.**

\_\_\_\_\_ [2]

**[Total: 5]**

- 5 Four gases that are in the air are nitrogen, oxygen, argon and carbon dioxide.

(a) Draw a straight line to connect the NAME of each gas to the correct ARRANGEMENT OF ATOMS AND ITS RELATIVE MASS.

NAME	ARRANGEMENT OF ATOMS AND ITS RELATIVE MASS
nitrogen	 relative mass = 32
oxygen	 relative mass = 40
argon	 relative mass = 44
carbon dioxide	 relative mass = 28

[2]

**(b) Which of the following statements about gases in the air are TRUE?**

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

**All of the gases in the air are elements.**

☐

**Air contains only non-metal elements.**

☐

**There are weak attractions between molecules in air.**

☐

**All the gases have high melting points and boiling points.**

☐

**The gases are good conductors of electricity.**

☐

**[2]**

- (c) Molecules in the air contain atoms that are held together by strong covalent bonds.**

**Which of the following statements are the BEST descriptions of covalent bonds in these molecules?**

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

**A covalent bond is made by sharing electrons.**

☐

**The atoms gain positive or negative charges when the bond is made.**

☐

**The atoms are held together by the attractions between the nuclei of the atoms and the electrons between them.**

☐

**Each atom is surrounded by a sea of electrons that can move.**

☐

**The atoms are bonded covalently into large, three dimensional structures.**

☐

**[2]**

**[Total: 6]**

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**6 Amy and Zak test samples of the same solution.**

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

**They use a fresh sample for each test.**

**The boxes on the next page show the tests they use and their results.**

<b>ZAK'S RESULTS</b>	
<b>TEST</b>	<b>RESULT</b>
Add a few drops of dilute sodium hydroxide...	white precipitate
...then add more dilute sodium hydroxide.	precipitate dissolves
Acidify and add dilute silver nitrate.	white precipitate
<b>CONCLUSION</b>  The solution only contains zinc chloride.	

<b>AMY'S RESULTS</b>	
<b>TEST</b>	<b>RESULT</b>
Add a few drops of dilute sodium hydroxide.	white precipitate
Acidify and add dilute silver nitrate.	white precipitate
Acidify and add dilute barium chloride.	white precipitate
<b>CONCLUSION</b>  The solution contains a mixture of calcium sulfate and calcium chloride.	

Use the data sheet on pages 4–5 to help you answer this question.

Amy and Zak’s teacher tells them that **NEITHER** of their conclusions are fully correct.

Look at Amy and Zak’s tests and their results.

Explain why neither Amy or Zak has a fully correct conclusion.

Identify the correct metal and non-metal ions in the solution.



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

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[6]

[Total: 6]

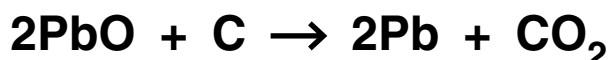
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**7 Jed and Kay live near a lead mine.**

**The mineral massicot is dug out of this mine.**

**Massicot contains lead oxide, PbO.**

**Lead metal can be extracted from massicot by heating it with carbon.**



**(a) What is the maximum mass of lead that can be extracted from 446 g of lead oxide?**

**Use the Periodic Table to find the relative atomic masses.**

**Start by working out the relative formula mass of lead oxide.**

**relative formula mass of lead oxide, PbO = \_\_\_\_\_**

**mass of lead that can be extracted  
from 446 g lead oxide = \_\_\_\_\_ g**

**[3]**

- (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.**

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**[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.**

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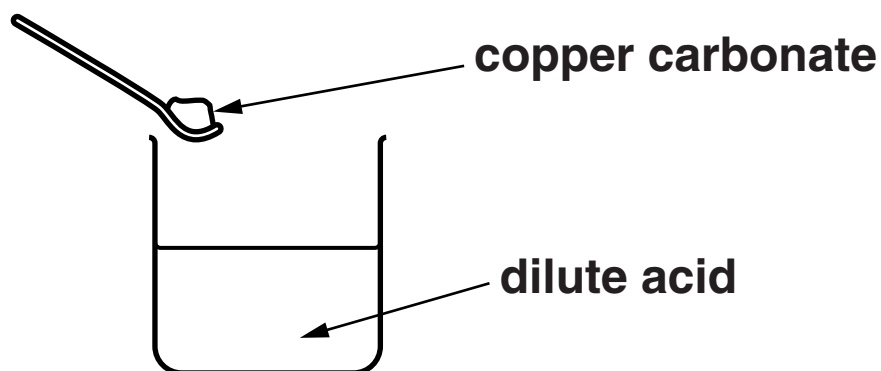
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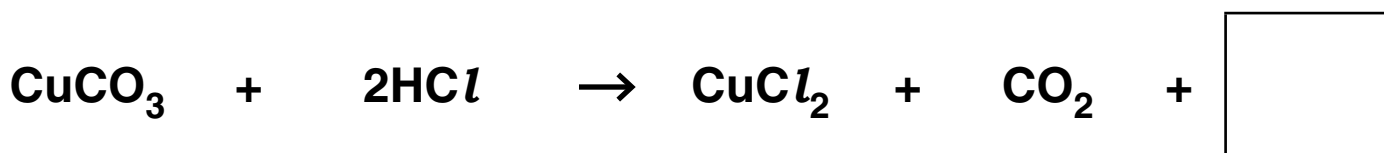
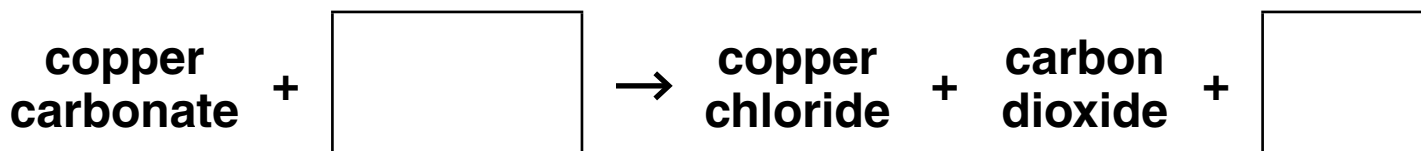
**[2]**

**[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.



[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) (i) Sue measures the pH during the reaction.**

**Describe and explain how the pH changes during the reaction.**

\_\_\_\_\_

\_\_\_\_\_ **[2]**

**(ii) What could Sue use to measure the pH?**

**Put ticks (✓) in the boxes next to EACH correct answer.**

**sodium hydroxide** ☐

**pH meter** ☐

**litmus** ☐

**universal indicator** ☐

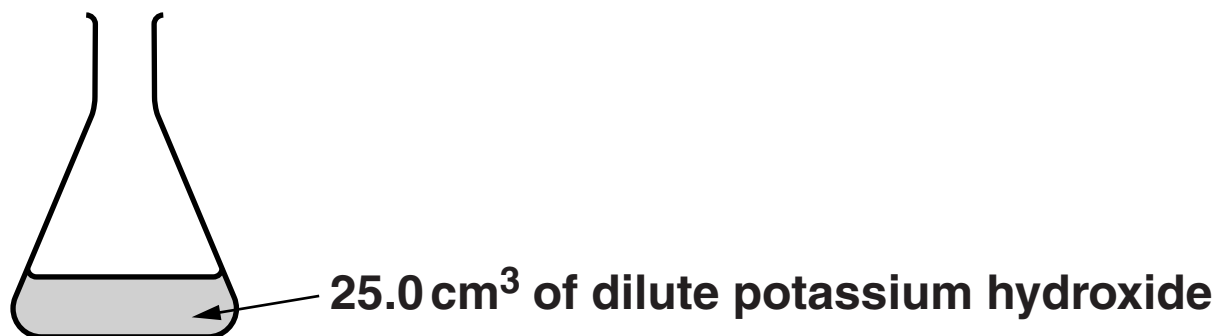
**[1]**

**[Total: 6]**

**9 Alex wants to use a titration method to make some potassium sulfate.**

**(a) Alex begins by measuring  $25.0\text{ cm}^3$  of dilute potassium hydroxide into a flask.**

**He reacts the potassium hydroxide with dilute sulfuric acid.**



**Alex does titrations to find out the volume of acid that exactly reacts with the  $25.0\text{ cm}^3$  dilute potassium hydroxide.**

**Describe in detail how Alex does the titrations.**



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

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**[6]**

- (b) (i) Alex makes a solution of potassium sulfate in his titration.

Alex makes crystals from his solution. He makes 4.5 g of potassium sulfate crystals.

This is 90% of his theoretical yield.

What is his THEORETICAL yield?

Put a ring around the correct answer.

0.05%

4.05 g

5 g

9 g

10%

45%

[1]

- (ii) Alex did not dry his crystals properly.

His crystals contained 1.0 g of water.

Calculate Alex's percentage yield after he has dried his crystals properly.

percentage yield = \_\_\_\_\_ % [2]

**(c) Alex's friend Ben does a similar experiment.**

**He starts with the same volume ( $25.0\text{ cm}^3$ ) of the same concentration of potassium hydroxide solution.**

**He neutralises this with a MORE DILUTE solution of acid.**

**(i) What factor is Ben changing in his experiment?**

\_\_\_\_\_ **[1]**

**(ii) What effect will changing this factor have on the mass of potassium sulfate crystals that Ben makes?**

**Explain your reasoning.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ **[2]**

**(d) Alex does some more experiments. He reacts dilute sodium hydroxide with hydrochloric acid.**

**He measures how much hydrochloric acid he needs to neutralise 20 cm<sup>3</sup> of dilute sodium hydroxide.**

**He tests different concentrations of hydrochloric acid.**

**He uses the SAME CONCENTRATION OF SODIUM HYDROXIDE every time.**

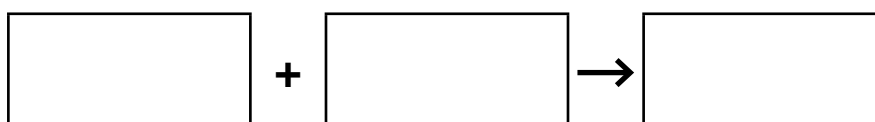
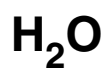
**The table shows some of Alex's results.**

<b>CONCENTRATION OF HYDROCHLORIC ACID IN g/dm<sup>3</sup></b>	<b>VOLUME OF HYDROCHLORIC ACID NEEDED TO NEUTRALISE 20 cm<sup>3</sup> SODIUM HYDROXIDE IN cm<sup>3</sup></b>
<b>10.0</b>	<b>80.0</b>
<b>20.0</b>	
<b>40.0</b>	<b>20.0</b>
	<b>13.3</b>
<b>80.0</b>	<b>10.0</b>

**(i) Complete the table by filling in the two empty boxes. [2]**

- (ii) Complete the ionic equation for the reaction that happens during neutralisation.

Choose formulae from this list.



[1]

[Total: 15]

**END OF QUESTION PAPER**

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