

Tuesday 22 January 2013 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY 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 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

Answer **all** the questions.

- 1 Caesium is an element. Compounds of caesium are found in some minerals.

Ben looks at a table of flame colours for different elements.

Element	Flame colour
caesium	blue
barium	green
calcium	red
copper	blue
potassium	purple
sodium	yellow

- (a) Ben does a flame test on a mineral to find out if it contains caesium.

Describe how to do a flame test.

.....

.....

..... [2]

- (b) After doing his test, Ben writes this note.

The flame colour was blue.

I am sure that the mineral does not contain calcium or sodium.

I am not sure whether it contains caesium.

- (i) Explain why Ben is sure that the mineral does **not** contain calcium or sodium.

.....

..... [2]

- (ii) From his results, Ben cannot be sure whether the mineral contains caesium.

Explain why.

.....

..... [2]

[Total: 6]

2 Jack writes down data about some elements in Group 7.

Element	Formula of molecule	Normal physical state (room temperature 20 °C)	Melting point in °C	Boiling point in °C
fluorine	F ₂	gas	–220	–188
chlorine	Cl ₂	gas	–101	–35
bromine	Br ₂	liquid	–7	–59
iodine	I ₂	solid	114	184

Jack has made a mistake. One of the boiling points is wrong.

(a) Which boiling point in the table is wrong?

Explain how you made your choice.

.....

 [2]

(b) Estimate the correct value for the boiling point.

..... °C [1]

(c) Astatine is another element in Group 7 of the Periodic Table.

What is the formula for a **molecule** of astatine?

..... [1]

[Total: 4]

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Question 3 begins on page 6

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3 Hydrogen and lithium are elements.

Lithium is in Group 1 of the Periodic Table.

The table shows some information about the properties of hydrogen and lithium.

	Hydrogen	Lithium
State at room temperature	gas	solid
Type of element	non-metal	metal
Number of electrons in outer shell of an atom	1	1
Ion	H ⁺	Li ⁺
Formula of chloride	HCl	LiCl
Reactivity	<p>'Pops' when lit.</p> <p>Does not react with water.</p> <p>Reacts with chlorine.</p>	<p>Only burns if heated strongly.</p> <p>Reacts with water.</p> <p>Reacts with chlorine.</p>



Guy



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

..... [6]

(b) Hydrogen gas reacts with lithium at high temperatures to make lithium hydride.

(i) At the temperatures of the reaction:

- lithium is a **liquid**
- lithium hydride is a **solid**.

Draw straight lines to join each **chemical** with its correct **state symbol at high temperature**.

chemical	state symbol at high temperature
lithium	(s)
hydrogen	(l)
lithium hydride	(g)
	(aq)

[2]

(ii) The formula for lithium hydride is LiH.

It is an ionic solid with properties similar to lithium chloride.

What properties is lithium hydride most likely to have?

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

- | | |
|---|--------------------------|
| It has a very low melting point. | ☐ |
| It is insoluble in water. | ☐ |
| The solid does not conduct electricity. | ☐ |
| The solid is made of crystals. | ☐ |

[2]

[Total: 10]

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Question 4 begins on page 10

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- 4 Sam does some research about the properties of diamond and graphite.

The table shows what he finds out.

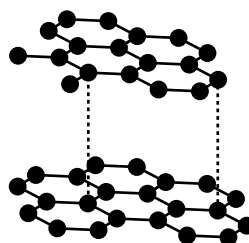
	Diamond	Graphite
Melting point in °C	3560	3650
Boiling point in °C	4830	4830
Solubility in water	insoluble	insoluble
Electrical conductivity	does not conduct	good conductor
Hardness	very hard	soft, flakes easily

Sam notices that some of the properties are similar and some are different.

He finds diagrams that show the structures of diamond and graphite.



diamond



graphite

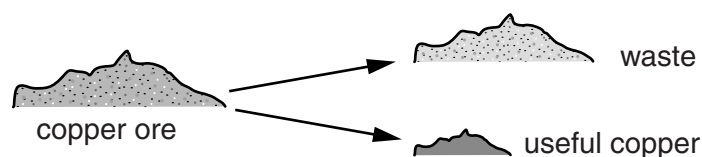


[6]

[Total: 6]

- 5 Zoe works for a company that mines copper ores.

She tests different copper ores to find out how much useful copper can be extracted from each one.



The table shows some of her results.

	Mass of ore in g	Mass of copper extracted from the ore in g	Mass of copper extracted per gram of ore	Mass of copper extracted per kilogram of ore
Ore 1	200	10	$10 \div 200 = 0.05 \text{ g}$	50 g
Ore 2	200	15	$15 \div 200 = 0.075 \text{ g}$	75 g
Ore 3	200	12		

- (a) (i) Calculate the mass of copper extracted per gram for **ore 3**.

answer g [2]

- (ii) Use your answer to calculate the mass of copper extracted per kilogram for **ore 3**.

answer g [1]

- (iii) The company wants to make as little waste as possible when it extracts copper.

Which of the ores should the company use?

Explain why.

.....
 [2]

(b) Zoe and her friends discuss some issues about extracting copper.



Zoe

The company extracts as much copper as it can because it can be sold for a very high price. All electrical appliances and wiring need copper to work.



Dan

Copper ores that contain sulfur make sulfur dioxide gas when copper is extracted from them.



Ali

Sulfur dioxide causes acid rain, so that's not a good thing! The company should only use ores that don't contain sulfur.



Jack

The company can put equipment in their chimneys to take the sulfur dioxide out of the waste gases.

(i) Use the information to describe the advantages and disadvantages of mining copper.

.....

.....

.....

..... [3]

(ii) Use the information to explain **one** way in which the mining company can make the extraction of copper more sustainable.

.....

..... [1]

- (iii) Dan says that compounds that contain sulfur make sulfur dioxide when copper is extracted from them.

Which compounds make sulfur dioxide when copper is extracted from them?

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



[1]

[Total: 10]

6 Mars is a planet in our solar system.

The table shows the percentage of each gas in the atmosphere on Mars.

Name of gas	Percentage in atmosphere on Mars
carbon dioxide	95.3%
nitrogen	2.7%
argon	1.6%
oxygen	0.13%

(a) Which of the statements about the gases on Mars are true?

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

Most of the atmosphere on Mars is nitrogen.

☐

The gases on Mars are all found on Earth.

☐

All of the gases are elements.

☐

There is more argon than oxygen on Mars.

☐

The percentage of oxygen on Mars is the same as on Earth.

☐

[2]

(b) Draw straight lines to connect each **gas in the atmosphere** with its correct **formula**.

gas in the atmosphere

formula

nitrogen

NO₂

N₂

argon

Ar

ArO₂

oxygen

O

O₂

[2]

[Total: 4]

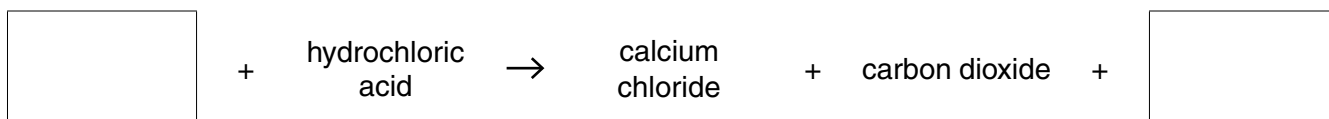
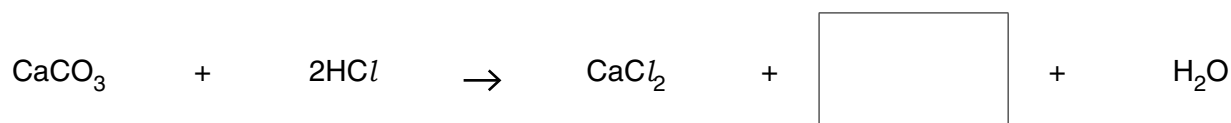
- 7 Alex adds dilute hydrochloric acid to solid calcium carbonate.

He sees that the reaction makes bubbles of gas.



- (a) Alex writes **word** and **symbol** equations for the reaction between calcium carbonate and hydrochloric acid.

Complete the equations by filling in the boxes.

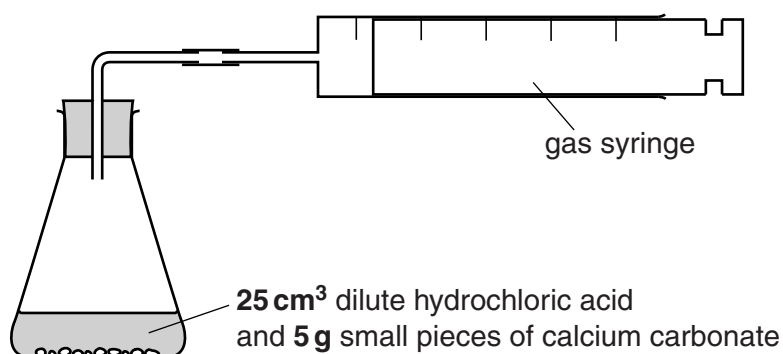


[3]

- (b) Alex reacts small pieces of calcium carbonate with dilute hydrochloric acid.

He measures the time taken for the reaction to make 20 cm^3 of gas.

He uses this equipment.



Mass of calcium carbonate	Time taken to make 20 cm³ gas
5 g small pieces	50 s

Alex predicts that the reaction will be **slower** if he uses **large lumps** of **calcium carbonate**.

Alex does another experiment to find out if his prediction is right.

Write a plan for his experiment.

Your answer should include:

- the quantities he should use
- how he can make it a fair test
- how he will know if his prediction is right.



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

..... [6

(c) What other conditions could be changed to give a slower reaction?

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

use a more concentrated acid

☐

use a catalyst

☐

shake the flask

☐

use a lower temperature

☐

add water to the acid

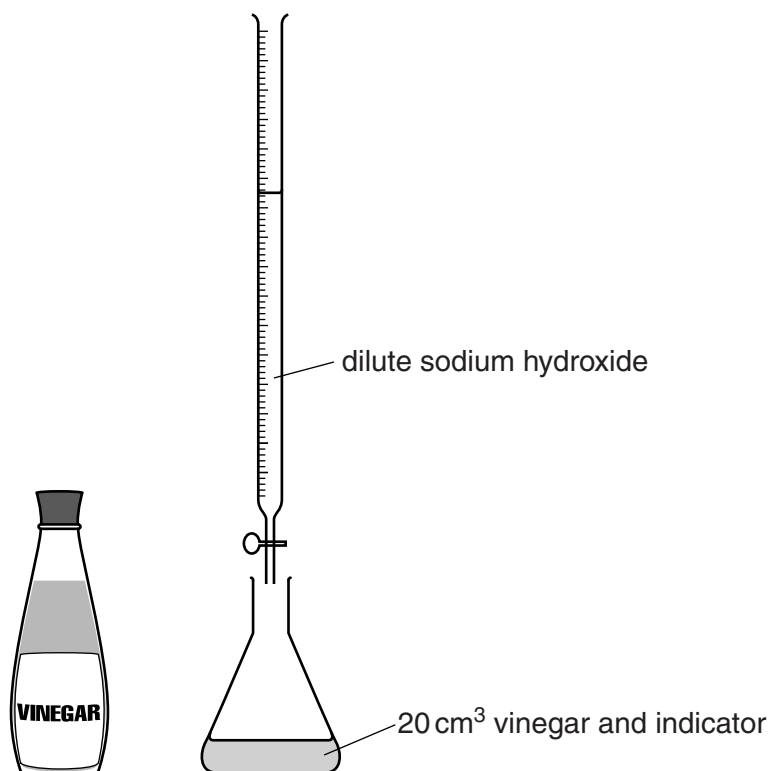
☐

[2]

[Total: 11]

- 8 Some students do titrations to find out the concentration of acid in vinegar.

The diagram shows the equipment they use.



Each student does a first titration then repeats the titration several times.

- (a) Each student calculates an average result from their repeats.

The first titration result is **not** used to calculate the average.

Which statement best explains why?

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

The first result is usually lower than the others.

The first titration is done without an indicator.

The students do not follow the method carefully the first time.

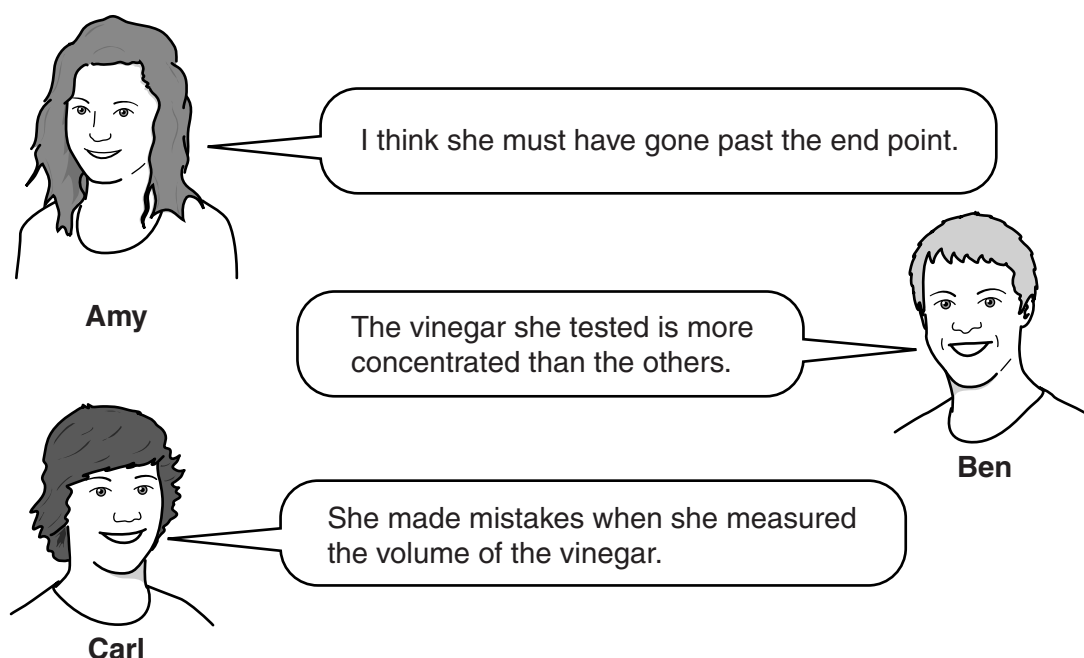
The first result is used to give a rough idea of the volume needed.

☐
☐
☐
☐

[1]

Name of student	Average volume of sodium hydroxide used in cm ³
Amy	23.4
Ben	24.1
Carl	23.8
Dee	18.2

They suggest explanations for this.



Explain why you **agree** or **disagree** with the ideas suggested by each student.

Reasoning [3]

(c) What is the word for the type of reaction that happens during this titration?

Put a ring around the correct answer.

crystallisation

evaporation

filtration

neutralisation

[1]

[Total: 5]

9 Magnesium sulfate is used to make medicines.

(a) Elly makes some magnesium sulfate by reacting magnesium oxide with sulfuric acid.

She uses this formula to work out her theoretical yield of magnesium sulfate.

$\text{theoretical yield} = 3 \times \text{mass of magnesium oxide used}$

In her experiment, she uses **5 g of magnesium oxide**.

Use Elly's formula to work out her **theoretical yield**.

..... g [1]

(b) Elly makes some more magnesium sulfate crystals using a different amount of magnesium oxide.

She weighs an empty dish.

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

weight of dish and crystals	206.5 g
weight of empty dish	201.0 g

(i) What mass of crystals has Elly made?

..... g [1]

(ii) For this experiment, Elly works out that her theoretical yield is 10.0 g.

Work out Elly's percentage yield.

Use this formula.

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

..... % [2]

[Total: 4]

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.