AQA GCSE CHEMISTRY (4421)

CHEMISTRY



EXAM QUESTION PACK

UNIT C2 FOUNDATION TIER CHY2F PAPERS

STEMUP

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2012

Additional Science
Unit Chemistry C2

CHY2F

F

Chemistry
Unit Chemistry C2

Written Paper

Thursday 24 May 2012 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

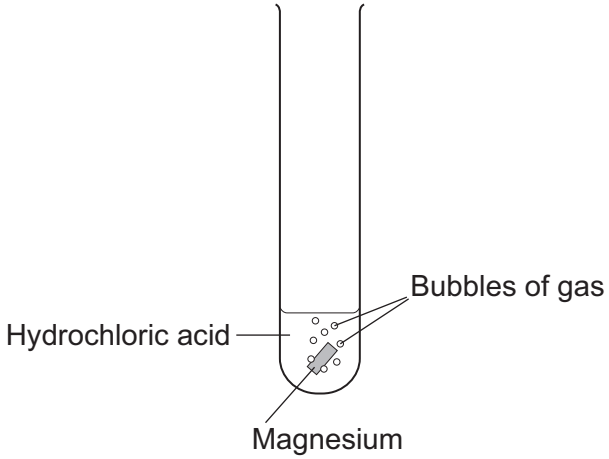
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Answer **all** questions in the spaces provided.

1 A student investigated the reaction of magnesium with hydrochloric acid.

1 (a) A piece of magnesium was dropped into the hydrochloric acid.



Bubbles of gas were produced and the magnesium disappeared.

The reaction is exothermic.

1 (a) (i) What measurements would the student make to show that the reaction is exothermic?

.....

.....

.....

.....

(2 marks)

1 (a) (ii) How would these measurements show that the reaction is exothermic?

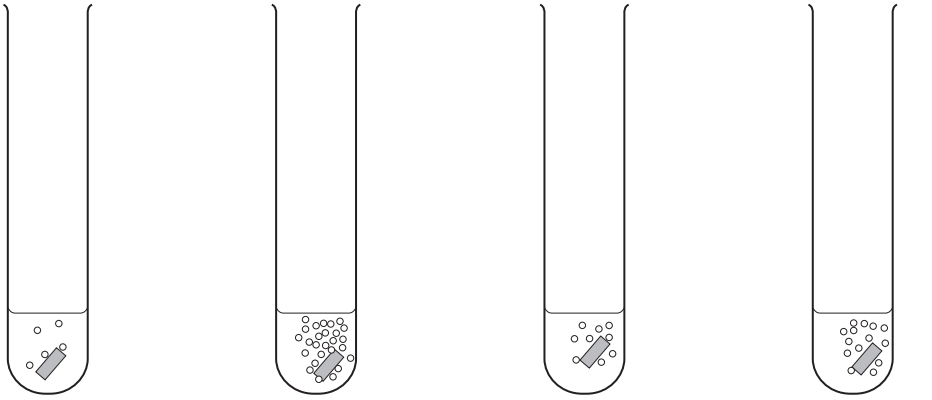
.....

(1 mark)

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The student investigated how changing the concentration of the hydrochloric acid affects this reaction.

Each test tube contained a different concentration of hydrochloric acid.
The diagrams show the results of this experiment.



Test tube A **Test tube B** **Test tube C** **Test tube D**

1 (b) Suggest **one** control variable in this investigation.

.....

.....

(1 mark)

1 (c) (i) Which test tube, **A**, **B**, **C** or **D**, contained the greatest concentration of hydrochloric acid?

Test tube ☐

(1 mark)

1 (c) (ii) Why did you choose this test tube?

.....

.....

(1 mark)

1 (d) The student predicted that if the temperature of the acid was increased the reaction would take place faster.

Tick (✓) **two** statements in the table which explain why.

Statement	Tick (✓)
The particles move faster	
The particles collide with less energy	
The particles collide more often	
The particles are bigger	

(2 marks)

8

Turn over ▶

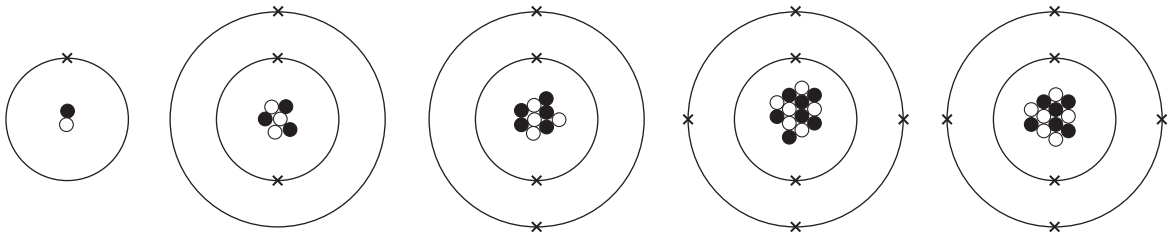
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ANSWER IN THE SPACES PROVIDED

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2 The diagrams show five different atoms, **A**, **B**, **C**, **D** and **E**.



Atom A **Atom B** **Atom C** **Atom D** **Atom E**

Key
○ represents a proton
● represents a neutron
× represents an electron

2 (a) Which atom, **A**, **B**, **C**, **D** or **E**:

2 (a) (i) has an atomic number (proton number) of 3 **Atom** ☐

(1 mark)

2 (a) (ii) has a mass number of 2 **Atom** ☐

(1 mark)

2 (a) (iii) is in Group 2 of the periodic table? **Atom** ☐

(1 mark)

2 (b) Which **two** atoms from **A**, **B**, **C**, **D** and **E** are isotopes of the same element?

Atom ☐ and **Atom** ☐ .

(1 mark)

2 (c) Which particle in an atom has a negative charge? .....

(1 mark)

5

Turn over for the next question

Do not write outside the box

3 Stage smoke is used for special effects at pop concerts.



Ammonium chloride can be used to make stage smoke.
Ammonium chloride is a white solid.
When heated, ammonium chloride produces white smoke which can be blown onto the stage.

The equation shows what happens when ammonium chloride is heated and cooled.

$$NH_4Cl(s) \underset{\text{cooled}}{\overset{\text{heated}}{\rightleftharpoons}} NH_3(g) + HCl(g)$$

ammonium chloride (white)	ammonia (colourless)	hydrogen chloride (colourless)

Do not write outside the box

3 (a) The sentences explain how the smoke is made.

Draw a ring around the correct answer in each box to complete each sentence.

Use the information and the equation to help you.

When heated, ammonium chloride makes two colourless | solids. / liquids. / gases. |

These are blown into the air where they cool and make a | colourless / black / white | | solid / liquid / gas |

which is | ammonia. / ammonium chloride. / hydrogen chloride. |

(4 marks)

3 (b) Complete the sentence.

The symbol $\rightleftharpoons$ means that the reaction is ..... .

(1 mark)

5

Turn over for the next question

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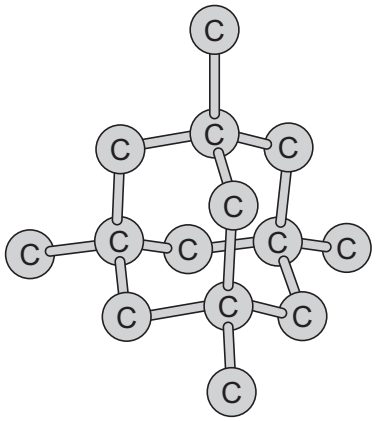
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ANSWER IN THE SPACES PROVIDED

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4 Liquids containing nanoparticles of diamond are used as abrasives.
Nanoparticles of diamond can be used to grind down surfaces to give them a very smooth polished finish.



Abrasive liquid containing nanoparticles of diamond



Model of part of the diamond structure

4 (a) Diamond is made of one element.
Draw a ring around the name of this element.

calcium **carbon** **chromium** **cobalt**

(1 mark)

4 (b) Tick (✓) **two** statements in the table which explain why diamond is hard.

Statement	Tick (✓)
It is made of layers.	
It has weak covalent bonds.	
Each atom is joined to four other atoms.	
It has a giant structure.	
It has strong ionic bonds.	

(2 marks)

4 (c) Draw a ring around the correct answer to complete the sentence.

Nanoparticles of diamond are

very small.

large.

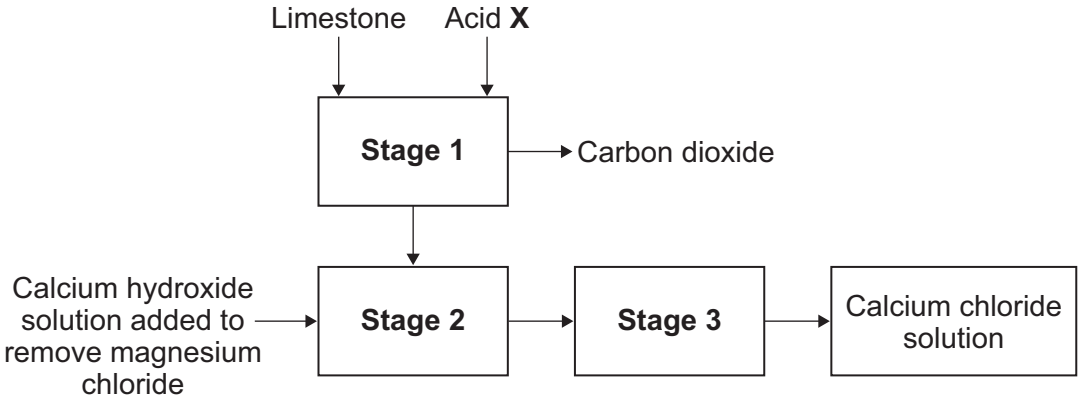
very large.

(1 mark)

4

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5 (a) Calcium chloride is made from limestone. Limestone contains mainly calcium carbonate and a small amount of magnesium carbonate.



5 (a) (i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Draw a ring around the name of acid **X**.

hydrochloric **nitric** **sulfuric**

(1 mark)

5 (a) (ii) **Stage 1** produces a concentrated solution of calcium chloride.
The solution also contains magnesium chloride.

Calcium hydroxide solution is added in **stage 2** to remove the magnesium chloride.

The equation for this reaction is:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

Draw a ring around the correct answer to complete each sentence.

In **stage 2** a precipitate is made because magnesium hydroxide is [dissolved / insoluble / soluble] in water.

In **stage 3** the solid magnesium hydroxide can be separated from the calcium chloride solution using [chromatography. / electrolysis. / filtration.]

(2 marks)

Do not write outside the box

5 (a) (iii) What method can be used to change the calcium chloride solution into solid calcium chloride?
Draw a ring around your answer.

crystallisation **electrolysis** **reduction**

(1 mark)

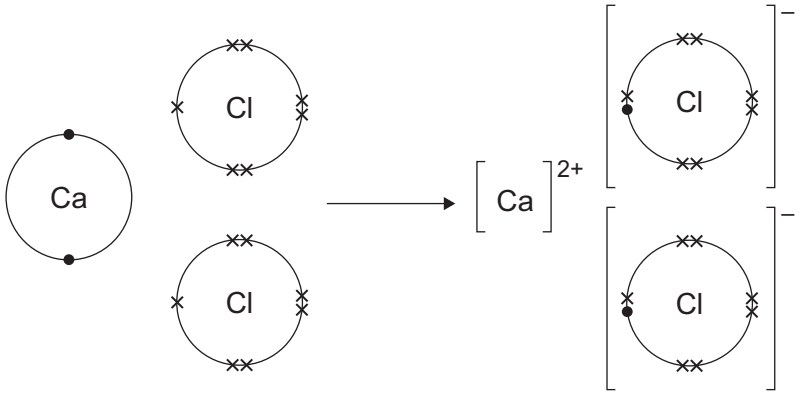
5 (b) Calcium chloride can also be made by reacting calcium with chlorine:

calcium + chlorine → calcium chloride

The diagram shows what happens to atoms of calcium and chlorine in this reaction.

The dots (•) and crosses (×) are used to represent electrons.

Only the outer electrons are shown.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when calcium reacts with chlorine to make calcium chloride.

.....

.....

.....

.....

.....

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.....

.....

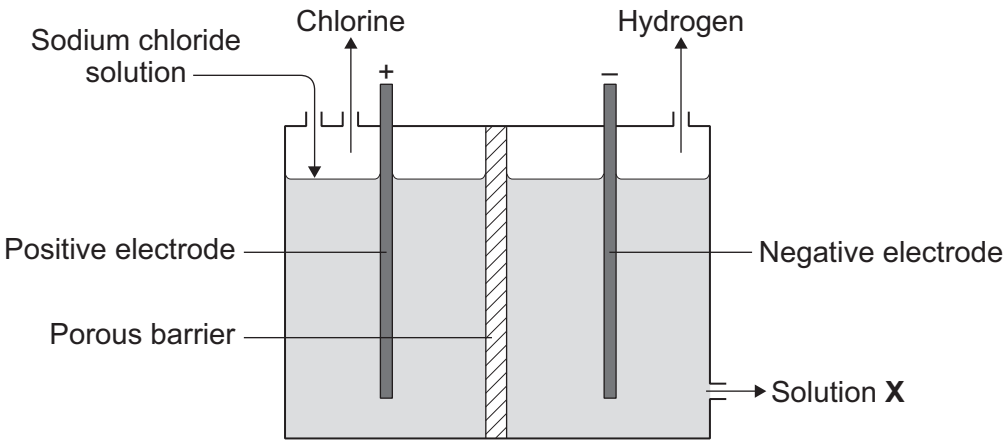
(4 marks)

8

Turn over ▶

Do not write outside the box

6 The electrolysis of sodium chloride solution is an industrial process.



6 (a) Why do chloride ions move to the positive electrode?

.....

(1 mark)

6 (b) Sodium chloride solution contains two types of positive ions, sodium ions (Na^+) and hydrogen ions (H^+).

Tick (✓) the reason why hydrogen is produced at the negative electrode and **not** sodium.

Reason	Tick (✓)
Hydrogen is a gas.	
Hydrogen is less reactive than sodium.	
Hydrogen is a non-metal.	
Hydrogen ions travel faster than sodium ions.	

(1 mark)

6 (c) Solution **X** is alkaline.

Which ion makes solution **X** alkaline?

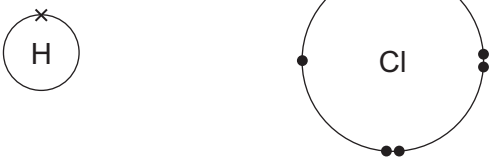
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(1 mark)

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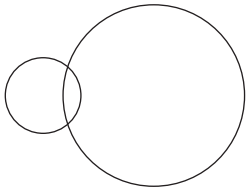
6 (d) Electrolysis of sodium chloride solution produces hydrogen and chlorine. The hydrogen and chlorine can be used to make hydrogen chloride.

6 (d) (i) The diagrams show how the outer electrons are arranged in atoms of hydrogen and chlorine.



Hydrogen atom Chlorine atom

Complete the diagram to show how the electrons are arranged in a molecule of hydrogen chloride (HCl).



(1 mark)

6 (d) (ii) Name the type of bond between the hydrogen and the chlorine atoms in a molecule of hydrogen chloride.

.....

(1 mark)

6 (d) (iii) Some hydrogen chloride was bubbled into water. This made a solution with a pH of 1.

Which ion gave the solution a pH of 1?

.....

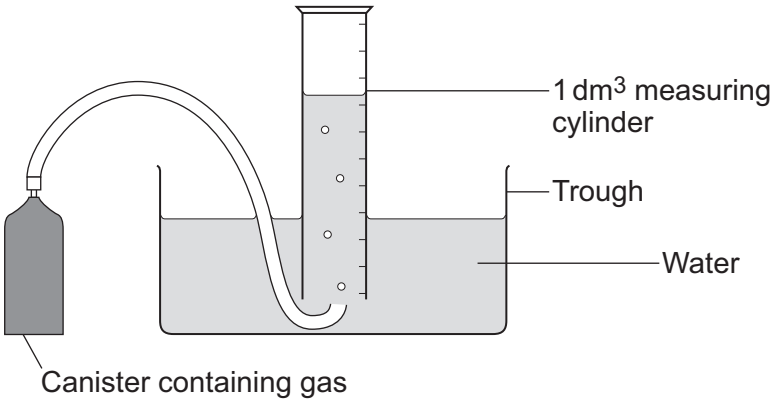
(1 mark)

6

Turn over for the next question

Do not write outside the box

7 Some students did an experiment to find the relative formula mass (M_r) of a gas.



This is the method they used.

- The mass of the canister of gas was measured using a balance, which weighed to two decimal places.
- The measuring cylinder was filled with 1 dm^3 of the gas from the canister.
- The mass of the canister of gas was measured again.
- The temperature of the laboratory was measured.
- The air pressure in the laboratory was measured.

The students repeated the experiment three times.

7 (a) The results for one of the experiments are shown in the table below.

Mass of the canister of gas before filling the measuring cylinder	53.07 g
Mass of the canister of gas after filling the measuring cylinder	51.21 g

Calculate the mass of the 1 dm^3 of gas in the measuring cylinder.

.....

Mass = ... g

(1 mark)

7 (b) How could the results be made more precise?

.....

.....

(1 mark)

Do not write outside the box

7 (c) The students used their results to calculate values for the relative formula mass (M_r) of this gas.
The results are shown in the table below.

Experiment	**1**	**2**	**3**	**4**
Relative formula mass (M_r)	45.4	51.5	46.3	45.8

7 (c) (i) Calculate the mean value for these results.

.....

Mean = ...
(2 marks)

7 (c) (ii) The four results are different.
The students thought this was because of experimental error.

Suggest **two** causes of experimental error in this experiment.

.....

.....

.....

.....
(2 marks)

7 (c) (iii) It was important for the students to repeat the experiment.
Suggest why.

.....

.....
(1 mark)

7 (d) The teacher told the students that the formula of the gas is C_3H_8

Calculate the relative formula mass (M_r) of this gas. You should show your working.

Relative atomic masses: H = 1; C = 12.

.....

.....

Relative formula mass = ...
(2 marks)

9

END OF QUESTIONS

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Version : 10/08/2012



General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2012 examination – June series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)(i)	the temperature at start the temperature at end	ignore reference to bubbles / heat (measure) the temperature rise / change = **2** marks (measure) the temperature **1** mark	1 1
1(a)(ii)	temperature would increase	allow it gets hot(ter) / warm(er) or heat given off allow energy released / transferred	1
1(b)	any **one** from: • volume of acid • temperature of acid • size of magnesium ribbon • surface area of magnesium	 allow amount allow liquid allow volume / mass / amount ignore size of test tube and reference to water	1
1(c)(i)	(Test tube) B		1
1(c)(ii)	produces bubbles faster **or** faster rate of reaction	accept more bubbles allow most reactive	1
1(d)	The particles move faster The particles collide more often		1 1
Total			**8**

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CHY2F

Question 2

question	answers	extra information	mark
2(a)(i)	B		1
2(a)(ii)	A		1
2(a)(iii)	C		1
2(b)	D and E		1
2(c)	electron		1
Total			**5**

CHY2F

Question 3

question	answers	extra information	mark
3(a)	gases		1
	white		1
	solid		1
	ammonium chloride		1
3(b)	reversible	allow phonetic spelling allow goes both / two / either way(s)	1
Total			**5**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	carbon		1
4(b)	each atom is joined to four other atoms It has a giant structure		1 1
4(c)	very small		1
Total			**4**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	hydrochloric		1
5(a)(ii)	insoluble filtration		1 1
5(a)(iii)	crystallisation		1

Question 5 continues on the next page . . .

CHY2F

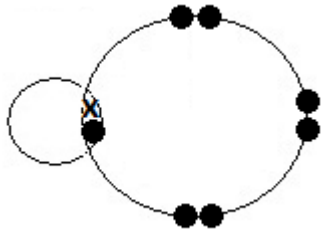
Question 5 cont'd..

question	answers	extra information	mark
5(b)	any **four** from: • calcium atom reacts with **2** chlorine atoms • calcium atoms lose electrons • lose **two** electrons • chlorine atoms **gain** electrons • gain one electron	any reference to incorrect bonding = max 3 accept calcium ion is formed accept calcium has a 2+ charge / calcium ion has a 2+ charge allow Ca^{2+} accept chloride ion formed accept chlorine / chloride has a negative charge / is a negative ion/ is a negative particle allow Cl^- if no other marks awarded allow ionic bonding **or** complete outer shell for **1** mark	4
Total			**8**

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Question 6

question	answers	extra information	mark
6(a)	any **one** from: • they are negative / anions • they are attracted • they are oppositely charged	allow Cl^- ignore atoms / chlorine do **not** accept chloride ions are negative electrodes	1
6(b)	hydrogen is less reactive than sodium		1
6(c)	hydroxide (ions) / OH^-	ignore OH do **not** accept NaOH / sodium hydroxide	1
6(d)(i)		allow any combination of dots or crosses ignore chemical symbols	1
6(d)(ii)	covalent	allow close spelling errors apply list principle	1
6(d)(iii)	hydrogen (ion) / H^+	ignore (aq) / H do **not** accept hydrochloric acid / HCl apply list principle	1
Total			**6**

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Question 7

question	answers	extra information	mark
7(a)	1.86	ignore units / 1.9	1
7(b)	use a balance which weighs to more decimal places **or** use more sensitive balance	accept (use a measuring cylinder with) smaller (scale) divisions / intervals allow reference to more decimal places allow smaller units / scale	1
7(c)(i)	45.8(3333333)	correct answer gains **2** marks with or without working ignore units / 46 if the answer is not correct then evidence of: (45.4 + 46.3 + 45.8) ÷ 3 **or** 137.5 ÷ 3 **or** 47.25 / 47.3 / 47.2 gains **1** mark	2

Question 7 continues on the next page . . .

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Question 7 cont'd…

question	answers	extra information	mark
7(c)(ii)	any **two** from: • loss of gas **or** leak • error in measurement of volume of gas / gas in cylinder / 1 dm^3 • error in weighing the canister / gas at start • error in weighing the canister / gas at end • change in temperature • change in pressure	ignore zero error / faulty equipment error in weighing the canister / gas = **1** mark allow incorrect measurement of temperature allow incorrect measurement of pressure if no other mark awarded allow error in weighing for **1** mark	2
7(c)(iii)	any **one** from: • check for anomalous results • to find the mean / average • (improve) reliability / make reliable	ignore fair test / precise / valid **or** to check for errors / mistakes allow improve (accuracy of) <u>mean</u> / <u>average</u>	1
7(d)	44	correct answer gains **2** marks with or without working ignore units if the answer is incorrect evidence of (3 x 12) / 36 **and** (8 x 1) / 8 gains **1** mark	2
Total			**9**

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Centre Number						Candidate Number				
Surname										
Other Names										
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Question	Mark
1	
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7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
January 2012

Additional Science
Unit Chemistry C2

CHY2F

F

Chemistry
Unit Chemistry C2

Written Paper

Thursday 26 January 2012 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
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- In all calculations, show clearly how you work out your answer.

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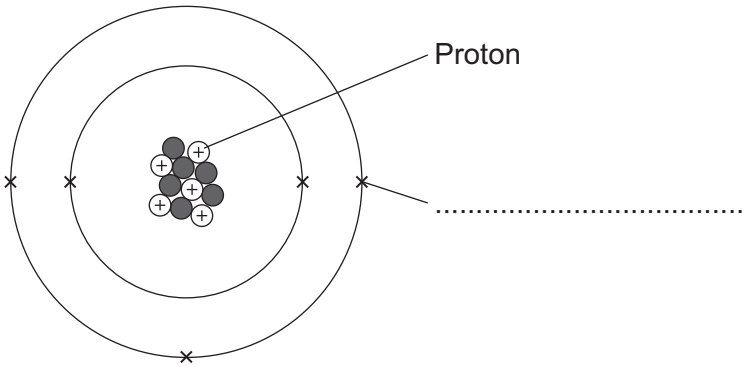
Do not write outside the box

Answer **all** questions in the spaces provided.

1 The diagram represents an atom of an element.

1 (a) Choose **one** word from the box to complete the label on the diagram.

electron	**neutron**	**nucleus**



(1 mark)

1 (b) (i) What is the atomic (proton) number of this atom? .....

(1 mark)

1 (b) (ii) Name the element.

Use the periodic table on the Data Sheet to help you answer this question.

The name of the element is ..... .

(1 mark)

1 (c) (i) Draw a ring around the mass number of this atom.

5 **11** **16**

(1 mark)

Do not write outside the box

1 (c) (ii) Another atom of this element has a different mass number.

Draw a ring around the correct word in the box to complete the sentence.

Atoms of the same element with different numbers of | electrons / neutrons / protons | are called isotopes.

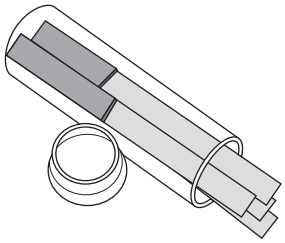
(1 mark)

5

Turn over for the next question

Do not write outside the box

2 Read the information and then answer the questions.



COBALT CHLORIDE PAPER

Cobalt chloride paper can be used to test for water.

The paper contains anhydrous cobalt chloride.

The jar containing the papers must be kept closed when not being used.

The equation shows the reaction between anhydrous cobalt chloride and water.

$$CoCl_2 + 6\,H_2O \rightleftharpoons CoCl_2.6H_2O$$

anhydrous cobalt chloride (blue) — hydrated cobalt chloride (pink)

2 (a) Choose **one** word from the box to complete the sentence.

endothermic	**exothermic**	**reversible**

The symbol $\rightleftharpoons$ means that the reaction is ..... .

(1 mark)

Do not write outside the box

2 (b) Describe the colour change when water is added to the cobalt chloride paper.

.....

.....

(1 mark)

2 (c) Suggest why the jar containing the unused cobalt chloride papers must be kept closed.

.....

.....

(1 mark)

3

Turn over for the next question

Do not write outside the box

3 (a) Ammonia solution is used in cleaning products to remove grease from kitchen surfaces.



Ammonia solution is alkaline.

3 (a) (i) Draw a ring around the number most likely to be the pH of ammonia solution.

1 **3** **7** **10**

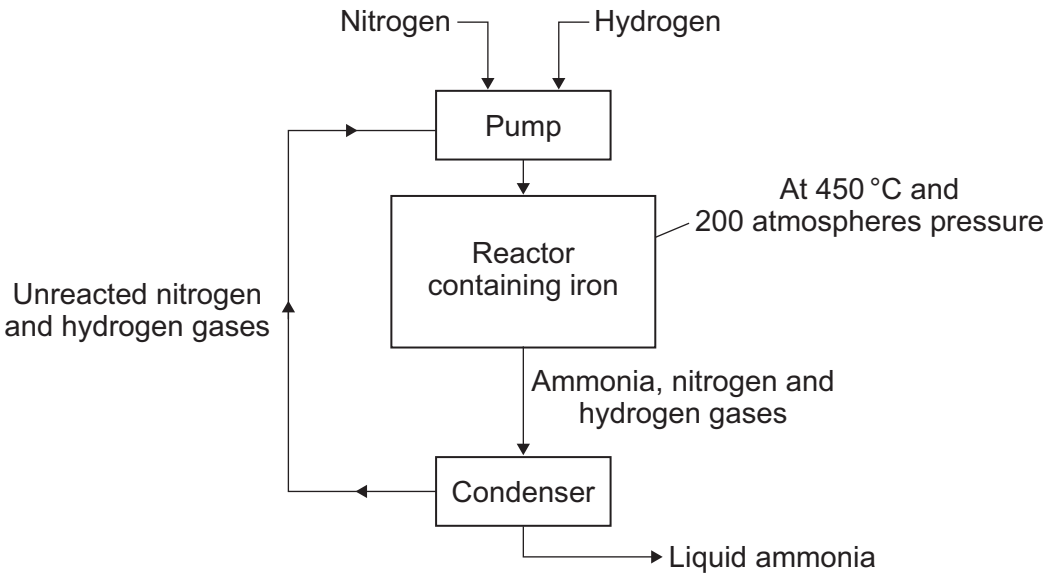
(1 mark)

3 (a) (ii) Draw a ring around the ion in ammonia solution which makes it alkaline.

Cl^- **H^+** **Na^+** **OH^-**

(1 mark)

3 (b) Ammonia is made using the Haber process.



Do not write outside the box

3 (b) (i) Where does the nitrogen used in the Haber process come from?

Draw a ring around your answer.

air **natural gas** **water**

(1 mark)

3 (b) (ii) A high temperature of 450 °C is used in the reactor.

Tick (✓) **two** reasons in the table which explain why high temperatures make reactions faster.

Reasons	Tick (✓)
Particles move faster	
Particles are closer together	
Particles collide more often	
Particles have less energy	

(2 marks)

3 (b) (iii) The iron in the reactor speeds up the reaction but is not used up.

What is the name given to substances that speed up the chemical reaction but which are not used up during the reaction?

.....

(1 mark)

3 (c) Complete the sentence.

The condenser separates the ammonia from the unreacted nitrogen and hydrogen by

turning the ammonia into a ..... .

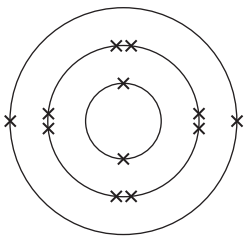
(1 mark)

7

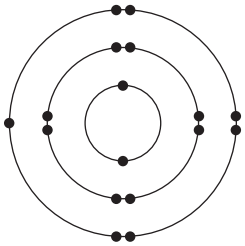
Turn over for the next question

Do not write outside the box

4 The diagrams represent the electronic structure of a magnesium atom and a chlorine atom.



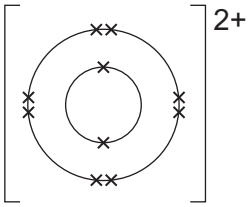
Magnesium atom



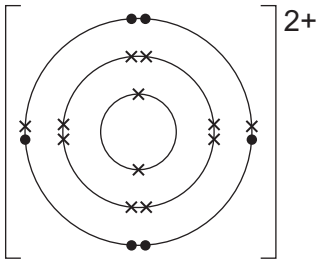
Chlorine atom

Magnesium reacts with chlorine to make the ionic compound called magnesium chloride. This contains magnesium ions, Mg^{2+}, and chloride ions, Cl^{-}

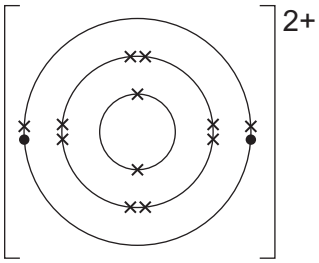
4 (a) (i) Which structure, **A**, **B** or **C**, represents a magnesium ion?



Structure **A**



Structure **B**

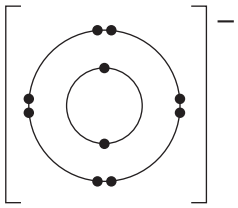


Structure **C**

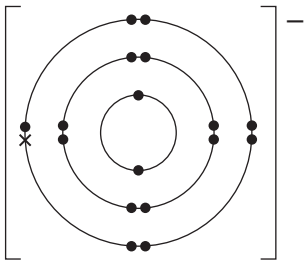
The magnesium ion is Structure ☐

(1 mark)

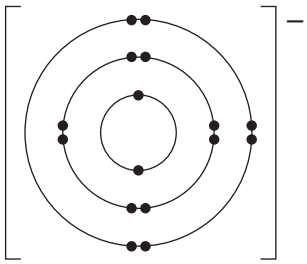
4 (a) (ii) Which structure, **D**, **E** or **F**, represents a chloride ion?



Structure **D**



Structure **E**



Structure **F**

The chloride ion is Structure ☐

(1 mark)

Do not write outside the box

4 (b) Magnesium metal can be extracted from sea water.
Sea water contains magnesium chloride, $MgCl_2$

4 (b) (i) Calcium hydroxide, $Ca(OH)_2$, is added to the sea water.
Magnesium hydroxide, $Mg(OH)_2$, is produced as a solid.

This is the equation for the reaction:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

Draw a ring around the correct answer to complete each sentence.

Magnesium hydroxide forms as a solid because it is [soluble / insoluble / dissolved] in water.

This type of reaction is called [precipitation. / neutralisation. / thermal decomposition.]

(2 marks)

4 (b) (ii) How is the solid magnesium hydroxide separated from the solution?

.....

(1 mark)

4 (b) (iii) An acid is then added to the solid magnesium hydroxide to make magnesium chloride.

Draw a ring around the name of this acid.

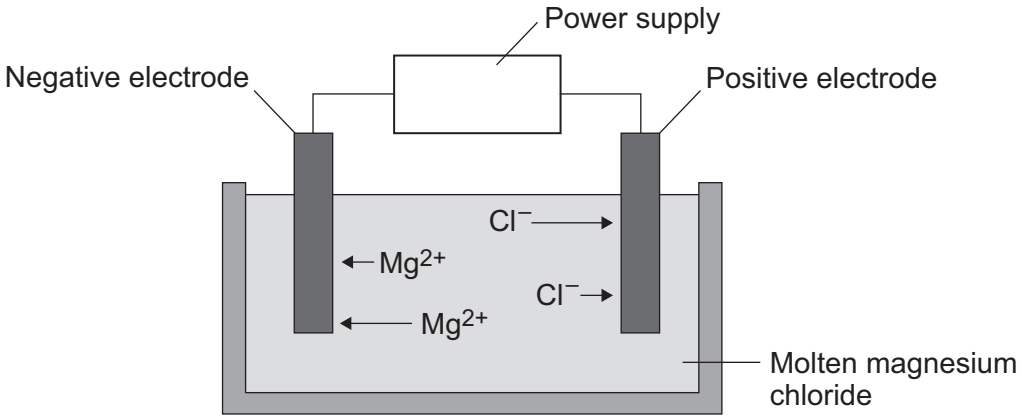
nitric acid **hydrochloric acid** **sulfuric acid**

(1 mark)

Question 4 continues on the next page

Do not write outside the box

4 (c) Electrolysis is used to extract magnesium metal from magnesium chloride.



4 (c) (i) What must be done to solid magnesium chloride to allow it to conduct electricity?

.....

(1 mark)

4 (c) (ii) Why do the magnesium ions move to the negative electrode?

.....

.....

(1 mark)

4 (c) (iii) Name the product formed at the positive electrode.

.....

(1 mark)

9

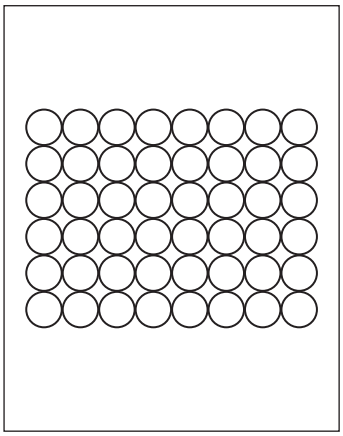
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Turn over for the next question

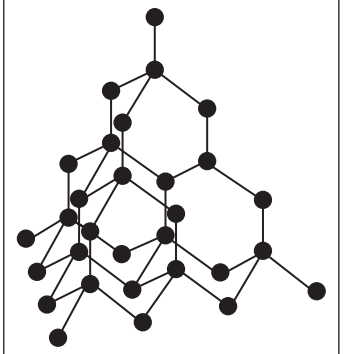
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ANSWER IN THE SPACES PROVIDED

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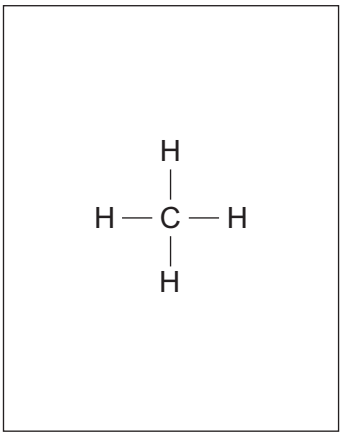
5 The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



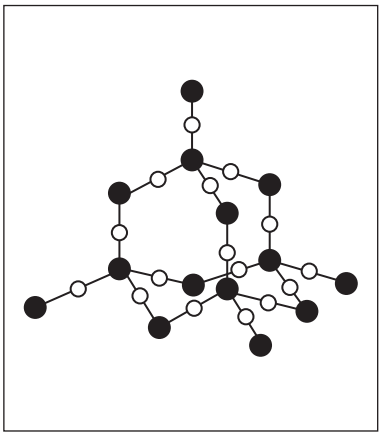
A



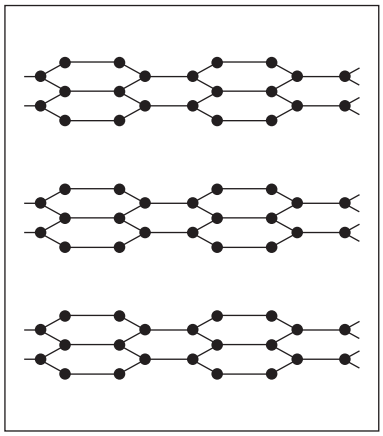
B



C



D



E

5 (a) Give **one** substance, **A**, **B**, **C**, **D** or **E**, that:

5 (a) (i) has a very low boiling point

(1 mark)

5 (a) (ii) is a compound

(1 mark)

5 (a) (iii) is a metal.

(1 mark)

Do not write outside the box

5 (b) Draw a ring around the type of bonding holding the atoms together in substance **C**.

covalent **ionic** **metallic**

(1 mark)

5 (c) Explain why substance **E** is soft and slippery.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Do not write outside the box

6 Read the information.

Alumina is a white solid. In 1800, scientists thought that alumina contained an undiscovered metal. We now call this metal aluminium. At that time, scientists could not extract the aluminium from alumina.

In 1825, Christian Oersted, a Danish scientist, did experiments with alumina.

Step 1 He reacted a mixture of hot alumina and carbon with chlorine to form aluminium chloride. The reaction is very endothermic.

Step 2 The aluminium chloride was reacted with potassium. He was left with potassium chloride and tiny particles of aluminium metal.

Other scientists were **not** able to obtain the same results using his experiment and his work was not accepted at that time.

In 1827, Friedrich Wöhler, a German chemist, made some changes to Oersted's experiment. He obtained a lump of aluminium. He tested the aluminium and recorded its properties.

6 (a) Suggest why scientists in 1800 could not extract aluminium from alumina.

.....

.....

(1 mark)

6 (b) Oersted's experiment in 1825 was **not** thought to be reliable.

Explain why.

.....

.....

(1 mark)

6 (c) Why must the reaction in **Step 1** be heated to make it work?

.....

.....

(1 mark)

Do not write outside the box

6 (d) Complete the word equation for the reaction in **Step 2**.

aluminium chloride + potassium → ..... + ...

(1 mark)

6 (e) Suggest how Wöhler was able to prove that he had made a new metal.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Do not write outside the box

7 Some students investigated magnesium oxide.

7 (a) Magnesium oxide has the formula MgO.

7 (a) (i) Calculate the relative formula mass (M_r) of magnesium oxide.

Relative atomic masses: O = 16; Mg = 24.

.....

.....

Relative formula mass = ...

(2 marks)

7 (a) (ii) Calculate the percentage by mass of magnesium in magnesium oxide.

.....

.....

Percentage by mass of magnesium in magnesium oxide = ...%

(2 marks)

7 (a) (iii) Calculate the mass of magnesium needed to make 25 g of magnesium oxide.

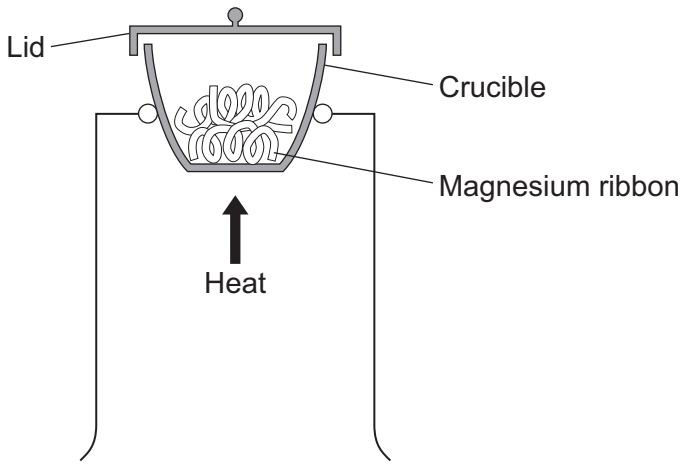
.....

Mass of magnesium = ... g

(1 mark)

7 (b) The students calculated that if they used 0.12 g of magnesium they should make 0.20 g of magnesium oxide.

They did this experiment to find out if this was correct.



Do not write outside the box

- The students weighed 0.12 g of magnesium ribbon into a crucible.
- They heated the magnesium ribbon.
- They lifted the lid of the crucible slightly from time to time to allow air into the crucible.
- The students tried to avoid lifting the lid too much in case some of the magnesium oxide escaped.
- When all of the magnesium appeared to have reacted, the students weighed the magnesium oxide produced.

The results of the experiment are shown below.

Mass of magnesium used in grams	0.12
Mass of magnesium oxide produced in grams	0.18

7 (b) (i) The mass of magnesium oxide produced was lower than the students had calculated. They thought that this was caused by experimental error.

Suggest **two** experimental errors that the students had made.

.....

.....

.....

.....

(2 marks)

7 (b) (ii) The students only did the experiment once.

Give **two** reasons why they should have repeated the experiment.

.....

.....

.....

.....

(2 marks)

9

END OF QUESTIONS

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Version : 07/03/2012

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2012 examination – January series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)	electron		1
1(b)(i)	5		1
1(b)(ii)	boron	accept B	1
1(c)(i)	11		1
1(c)(ii)	neutrons		1
Total			**5**

Question 2

question	answers	extra information	mark
2(a)	reversible		1
2(b)	(from blue) to pink	do **not** accept incorrect initial colour	1
2(c)	sensible answers such as: • stop water reaching papers • water (vapour) in air	 accept stop entry of moisture / wet / dampness / condensation ignore references to toxicity of cobalt chloride	1
Total			**3**

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CHY2F
Question 3

question	answers	extra information	mark
3(a)(i)	10		1
3(a)(ii)	OH^-		1
3(b)(i)	air		1
3(b)(ii)	particles move faster particles collide more often		1 1
3(b)(iii)	catalyst(s)		1
3(c)	liquid		1
Total			**7**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)(i)	A		1
4(a)(ii)	E		1
4(b)(i)	insoluble precipitation		2
4(b)(ii)	filtration	accept decant **or** centrifuge	1
4(b)(iii)	hydrochloric acid		1
4(c)(i)	melt	allow add to / dissolve in water allow heat until liquid allow turn it to liquid / make it molten ignore heat	1
4(c)(ii)	they are positive **or** opposite charges **or** opposites attract	 do **not** accept electrodes attracting do **not** accept positive electrons	1
4(c)(iii)	chlorine	accept Cl_2 do **not** accept chloride	1
Total			**9**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	C		1
5(a)(ii)	C **or** D		1
5(a)(iii)	A		1
5(b)	covalent		1
5(c)	layers can slide / move over each other	 accept are weakly bonded (owtte) allow no bonds between layers ignore slip / rub	1 1
Total			**6**

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CHY2F

Question 6

question	answers	extra information	mark
6(a)	any **one** from: • no method / electrolysis / equipment / technology • aluminium is a very reactive metal • high melting point • potassium had not been discovered	 allow 'didn't know how to' **or** 'no knowledge' allow 'couldn't heat it enough'	1
6(b)	because others / scientists / they could not repeat the experiment **or** others / they could not obtain the same results	ignore he could not repeat the experiment	1
6(c)	reaction is endothermic **or** reaction takes in heat / energy	accept activation energy ignore rate / high temperature ignore bonds broken	1
6(d)	(aluminium chloride + potassium) → aluminium + potassium chloride	in either order accept correct formulae ignore metal ignore balancing	1
6(e)	when tested it had the properties of a metal properties were different (from other known metals)	accept a test for a metal property eg conductivity / reaction with acid accept properties compared with other metals	1 1
Total			**6**

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CHY2F

Question 7

question	answers	extra information	mark
7(a)(i)	40	correct answer with or without working **or** incorrect working if the answer is incorrect then evidence of 24 + 16 gains **1** mark ignore units	2
7(a)(ii)	60	correct answer with or without working **or** incorrect working if the answer is incorrect then evidence of 24/40 **or** 24/(i) gains **1** mark ecf allowed from part(i) ie 24/(i) x100 ignore units	2
7(a)(iii)	15	ecf allowed from parts(i) and (ii) 24/(i) x 25 or (ii)/100 x 25 ignore units	1
7(b)(i)	any **two** from: • error in weighing magnesium / magnesium oxide • loss of magnesium oxide / magnesium • not all of the magnesium has reacted	ignore gas is lost allow some magnesium oxide left in crucible allow they lifted the lid too much allow loss of reactants / products allow not heated enough allow not enough oxygen / air	2

Question 7 continues on the next page……

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CHY2F

Question 7 continued

question	answers	extra information	mark
7(b)(ii)	any **two** from: • check that the result is not anomalous • to calculate a mean / average • improve the reliability • reduce the effect of errors	ignore fair test allow improve the accuracy of the mean / average allow make it reliable	2
Total			**9**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2011

Additional Science
Unit Chemistry C2

Chemistry
Unit Chemistry C2

CHY2F

F

Wednesday 25 May 2011 9.00 am to 9.45 am

For this paper you must have:
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

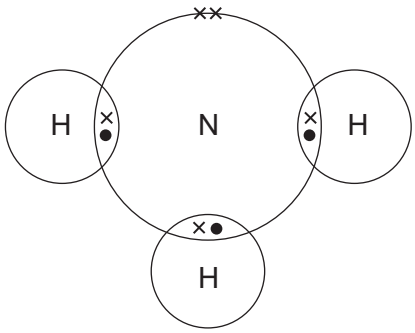
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

Answer **all** questions in the spaces provided.

1 The diagram shows how the atoms are bonded in ammonia.



1 (a) Draw a ring around the correct answer.

1 (a) (i) The formula of an ammonia molecule is

NH^3 **N_3H** **NH_3**

(1 mark)

1 (a) (ii) The particles represented by the dots (•) and crosses (×) in the diagram are

electrons **neutrons** **protons**

(1 mark)

1 (a) (iii) The bonds between the nitrogen and hydrogen atoms in ammonia are

covalent **ionic** **metallic**

(1 mark)

Do not write outside the box

1 (b) Ammonia is made by reacting nitrogen with hydrogen in the Haber process.
The equation for this reaction is shown below.

nitrogen + hydrogen $\rightleftharpoons$ ammonia

1 (b) (i) Use words from the box to complete the sentences.

air	**limestone**	**iron ore**	**natural gas**

Nitrogen is obtained from ..... .

Hydrogen is obtained from ..... .

(2 marks)

1 (b) (ii) Draw a ring around the correct answer to complete the sentence.

The symbol $\rightleftharpoons$ means that the reaction is

exothermic.

endothermic.

reversible.

(1 mark)

1 (b) (iii) A catalyst is used in the Haber process.

Draw a ring around the name of this catalyst.

iron **magnesium** **sodium**

(1 mark)

1 (c) Ammonium nitrate is a fertiliser that can be made by reacting ammonia with an acid.

Draw a ring around the name of the acid used in this reaction.

hydrochloric acid **nitric acid** **sulfuric acid**

(1 mark)

Question 1 continues on the next page

Do not write outside the box

1 (d) Humberstone was a town in the desert of Northern Chile in South America. It was built for the people who worked in the nearby sodium nitrate mines.

The sodium nitrate was used as a fertiliser.

The sodium nitrate was exported by ship to countries all around the world.

Today the mines have closed and nobody lives in Humberstone.



One of the reasons for the mines closing was the invention of the Haber process.

Haber process factories can be built anywhere in the world.

1 (d) (i) How did the invention of the Haber process affect the people of Humberstone?

.....

.....

(1 mark)

1 (d) (ii) Suggest **two** advantages of making ammonium nitrate in the UK rather than importing sodium nitrate from Chile.

1 .....

.....

2 .....

.....

(2 marks)

11

Do not write outside the box

2 The picture shows lumps of phosphate rock.



Phosphoric acid is made by reacting phosphate rock with sulfuric acid.

Only **three** of the methods shown below will **increase** the rate of this reaction.

Put a **tick** (✓) next to each of the **three** methods that will **increase** the rate of this reaction.

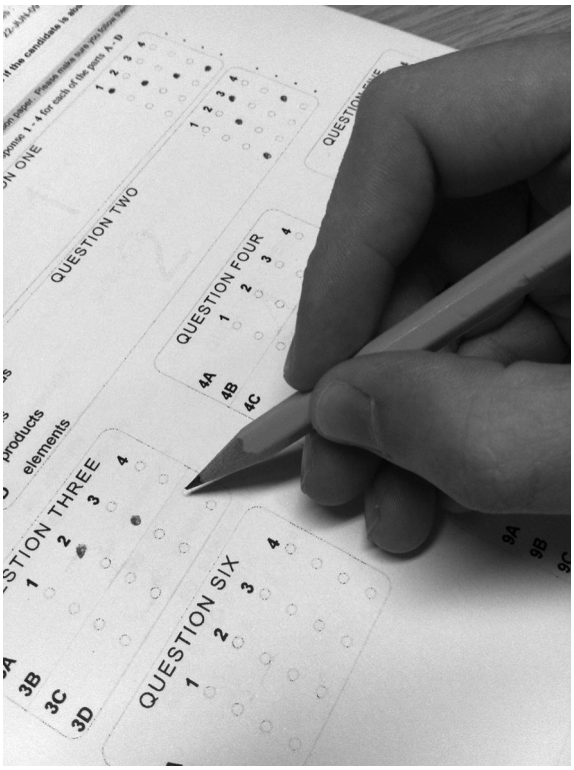
Method	Tick (✓)
Use a more concentrated solution of sulfuric acid	
Use larger lumps of phosphate rock	
Cool the mixture of phosphate rock and sulfuric acid	
Grind the phosphate rock into a powder before adding the acid	
Increase the temperature of the sulfuric acid	
Dilute the sulfuric acid solution with water	

(3 marks)

3

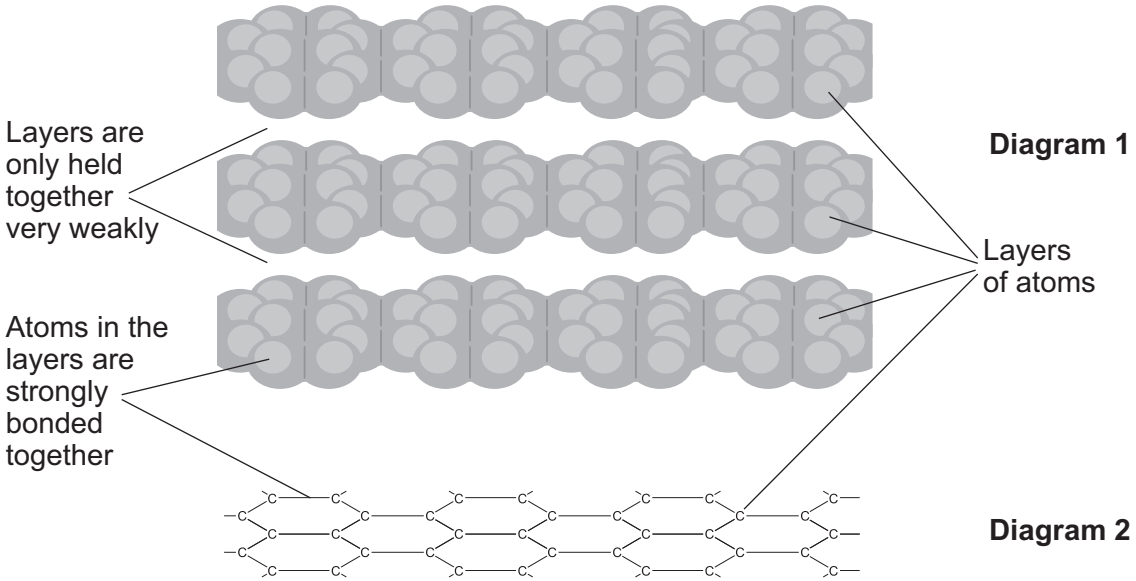
Do not write outside the box

3 The picture shows a student using a pencil to complete a multiple choice answer sheet.



The pencil contains graphite. Graphite rubs off the pencil onto the paper.

Diagrams 1 and **2** show how the atoms are arranged in graphite.



3 (a) Use **Diagram 2** and your Data Sheet to help you to name the element from which graphite is made.

.....

(1 mark)

Do not write outside the box

3 (b) Use **Diagram 1** to help you explain why graphite can rub off the pencil onto the paper.

.....

.....

.....

.....

(2 marks)

3 (c) Draw a ring around the type of bond which holds the atoms together in each layer.

covalent **ionic** **metallic**

(1 mark)

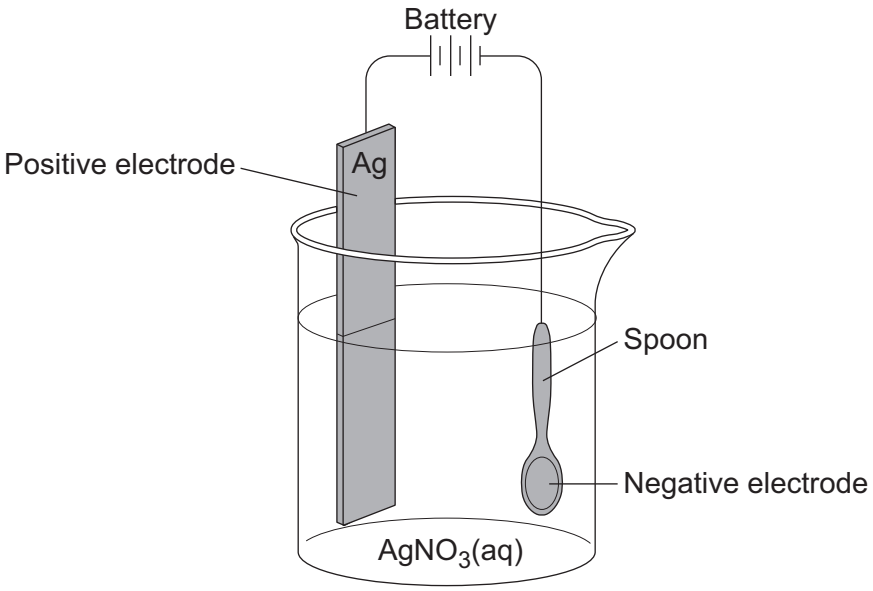
4

Turn over for the next question

Do not write outside the box

4 Electroplating is used to coat a cheap metal with a thin layer of an expensive metal.

In the diagram a teaspoon made of nickel is being coated with silver.



Silver nitrate, $AgNO_3$, contains silver ions (Ag^+) and nitrate ions (NO_3^-).

4 (a) Solid silver nitrate, $AgNO_3(s)$, does **not** conduct electricity.

Choose the correct answer in the box to complete the sentence.

are too big	**cannot move**	**are too small**

Solid silver nitrate does **not** conduct electricity because the ions

..... .

(1 mark)

4 (b) What substance is added to $AgNO_3(s)$ to turn it into $AgNO_3(aq)$?

Draw a ring around the correct answer.

petrol **alcohol** **water**

(1 mark)

Do not write outside the box

4 (c) Draw a ring around the correct answer to complete each sentence.

4 (c) (i) Silver ions move to the negative electrode because they have

no charge.

a negative charge.

a positive charge.

(1 mark)

4 (c) (ii) When silver ions reach the negative electrode they turn into silver

atoms.

compounds.

molecules.

(1 mark)

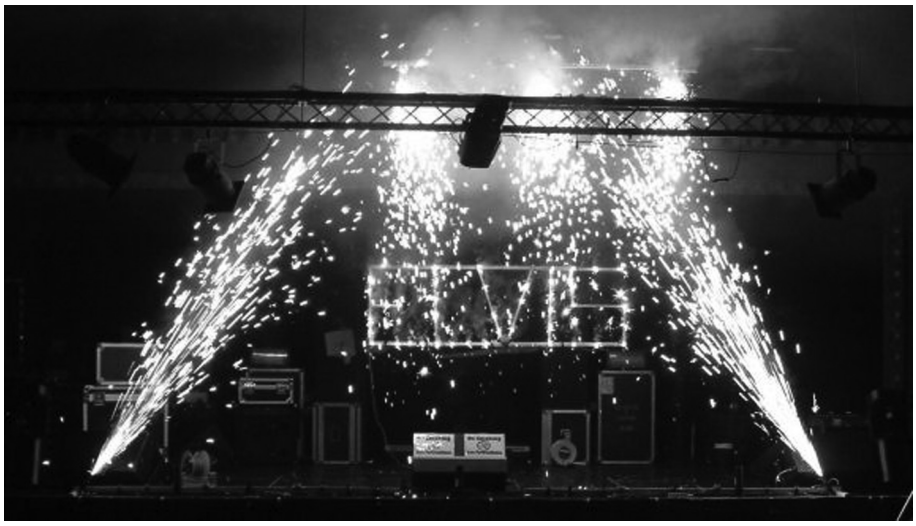
4

Turn over for the next question

Do not write outside the box

5 Read the information in the box.

Flash powder is used to produce special effects at pop concerts.



Flash powder contains aluminium. The powder burns with a bright white flame and gives out lots of heat and light. It also produces white smoke.

The flash powder is placed on stage in a special container. At the bottom of the container there is a thin piece of wire. When the flash is needed, electricity is passed through the wire. The wire gets hot and starts the aluminium burning.

5 (a) When aluminium burns the reaction is exothermic.

Give **one** piece of information from the box which shows that the reaction is exothermic.

.....

(1 mark)

5 (b) The hot wire provides energy to start the aluminium burning.

Draw a ring around the name given to the energy needed to start a chemical reaction.

activation energy **potential energy** **solar energy**

(1 mark)

5 (c) When aluminium burns it reacts with oxygen to make aluminium oxide.

Complete the word equation for this reaction.

aluminium + ... → .....

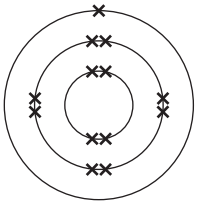
(1 mark)

Do not write outside the box

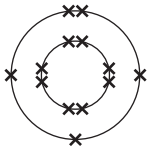
5 (d) An aluminium atom has 13 electrons.

Which diagram, **A, B** or **C**, represents the electronic structure of an aluminium atom?

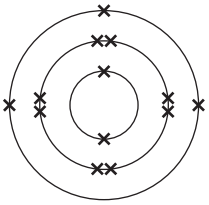
A



B



C



The electronic structure of an aluminium atom is diagram ☐

(1 mark)

5 (e) The white smoke produced is aluminium oxide.

Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

Draw a ring around the correct word in each box to complete each sentence.

5 (e) (i) Electrons have [a negative / no / a positive] charge.

(1 mark)

5 (e) (ii) When an aluminium atom (Al) turns into an aluminium ion (Al^{3+})

it [gains / loses / shares] three electrons.

(1 mark)

5 (e) (iii) When an oxygen atom (O) turns into an oxide ion (O^{2-})

it [gains / loses / shares] [one / two / three] electrons.

(2 marks)

8

Do not write outside the box

6 Read the article and then answer the questions.

TOXIC SOCKS?

Silver nanoparticles are added to the fibres used to make some socks. Silver has the special property that it can kill bacteria. As a result there are no unpleasant smells when wearing these socks.



Some scientists are concerned about the use of silver nanoparticles in socks.

The silver can be released from the socks when they are washed. This silver may end up in rivers. Silver in rivers may kill fish.

Scientists found that some makes of socks release the silver more easily than others. Socks in which the silver nanoparticles are trapped in the fibres released very little silver when washed.

6 (a) Suggest why silver stops unpleasant smells when wearing the socks.

.....

.....

(1 mark)

6 (b) How is the size of silver nanoparticles different from normal sized silver particles?

.....

(1 mark)

Do not write outside the box

6 (c) The silver nanoparticles are more effective at preventing unpleasant smells than normal sized silver particles.

Suggest why.

.....

.....

(1 mark)

6 (d) The silver nanoparticles should be trapped in the sock fibres.

Use the information in the article to explain why.

.....

.....

.....

.....

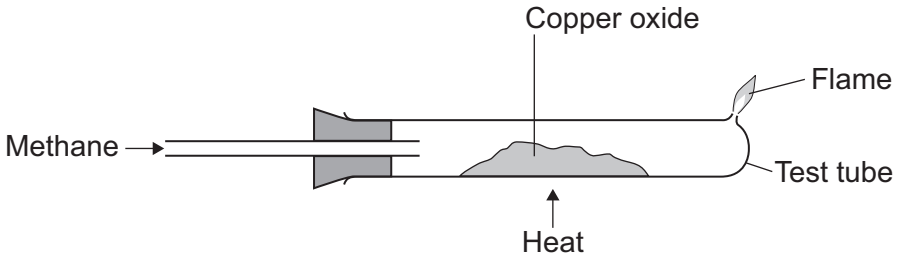
(2 marks)

5

Turn over for the next question

Do not write outside the box

7 An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



7 (a) The equation for this reaction is shown below.

$$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

.....

(1 mark)

7 (b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

.....

.....

.....

Relative formula mass (M_r) = ...

(2 marks)

7 (b) (ii) Calculate the percentage of copper in copper oxide.

.....

.....

.....

Percentage of copper = ... %

(2 marks)

Do not write outside the box

7 (b) (iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

.....

.....

Mass of copper = ... g

(1 mark)

7 (c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

7 (c) (i) Calculate the mean mass of copper made in these experiments.

.....

.....

Mean mass of copper made = ... g

(1 mark)

7 (c) (ii) Suggest how the results of these experiments could be made more precise.

.....

.....

(1 mark)

7 (c) (iii) The three experiments gave slightly different results for the mass of copper made.
This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 .....

.....

2 .....

.....

(2 marks)

10

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

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Version : 04/08/2011



General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2011 examination – June series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)(i)	NH_3		1
1(a)(ii)	electrons		1
1(a)(iii)	covalent		1
1(b)(i)	air natural gas		1 1
1(b)(ii)	reversible		1
1(b)(iii)	iron		1
1(c)	nitric acid		1
1(d)(i)	any **one** from: • lost jobs / unemployment • meant that they had to move away from Humberstone **or** no one lives there • loss of income (owtte)	 allow closed down the town ignore it closed the mine unless it is further qualified by some effect of this on the local community	1

Question 1 continues on the next page

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Question 1 continued

question	answers	extra information	mark
1(d)(ii)	any **two** from: • less transport (costs) • less pollution / greenhouse gases / global warming <u>from transport</u> • cheaper to make in country than to import • not dependent on Chile for nitrate supplies **or** reliable source • provides employment to workers in Britain • good for British economy • raw materials readily available • continuous process	ignore reference to environment / ecofriendly allow smaller carbon footprint ignore reference to quicker	2
Total			**11**

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CHY2F

Question 2

question	answers	extra information	mark
2	use a more concentrated solution of sulfuric acid grind the phosphate rock into a powder before adding the acid increase the temperature of the sulfuric acid		1 1 1
Total			**3**

CHY2F

Question 3

question	answers	extra information	mark
3(a)	carbon		1
3(b)	<u>layers</u> have weak forces / attractions / bonds between them **or** are only held together weakly **or** can slide over each other **or** separate (1)	 second mark must be linked to layers	1 1
3(c)	covalent		1
Total			**4**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	cannot move		1
4(b)	water		1
4(c)(i)	a positive charge		1
4(c)(ii)	atoms		1
Total			**4**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)	gives out / releases / transfers to surroundings heat / energy	ignore light / burns ignore the wire gets hot	1
5(b)	activation energy		1
5(c)	(aluminium +) oxygen (→) aluminium oxide	accept correct formulae	1
5(d)	C		1
5(e)(i)	a negative		1
5(e)(ii)	loses		1
5(e)(iii)	gains two		1 1
Total			**8**

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CHY2F

Question 6

question	answers	extra information	mark
6(a)	kills <u>bacteria</u> **or** stops growth of <u>bacteria</u>	allow destroys bacteria ignore attacks / reacts with bacteria ignore 'traps the smell' ignore microbes	1
6(b)	small<u>er</u> / <u>very</u> small / tiny	assume they are referring to nanoparticles unless they state otherwise accept 1 – 100nm in size accept a few hundred atoms in size accept normal size particles are (much) larg<u>er</u>	1
6(c)	any **one** from: • big(ger) surface area • react fast(er)	 accept more reactive ignore kill faster	1
6(d)	so they do not get released during washing **or** so they do not get into rivers / ecosystem / environment because this could harm fish / aquatic life **or** so the socks keep their odour – preventing properties (owtte)		1 1
Total			**5**

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CHY2F

Question 7

question	answers	extra information	mark
7(a)	because they are gases	ignore vapours / evaporate / (g) allow it is a gas	1
7(b)(i)	80 / 79.5	correct answer with or without working = **2** marks ignore units if no answer **or** incorrect answer then evidence of 64 / 63.5 + 16 gains **1** mark	2
7(b)(ii)	80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4	correct answer with or without working = **2** marks if no answer **or** incorrect answer then evidence of $\frac{64}{80}$ **or** $\frac{63.5}{79.5}$ (x100) gains **1** mark accept (ecf) $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ for **2** marks if correctly calculated if incorrectly calculated evidence of $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ gains **1** mark	2
7(b)(iii)	3.2	correct answer with or without working = **1** mark allow (ecf) 4 x ((b)(ii)/100) for **1** mark if correctly calculated	1

Question 7 continues on the next page

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Question 7 continued

question	answers	extra information	mark
7(c)(i)	3.3	accept 3.33…….. or $3\frac{1}{3}$ or 3.3̇ or 3.3^{r}	1
7(c)(ii)	measure to more decimal places **or** use a more sensitive balance / apparatus	allow use smaller scale (division) **or** use a smaller unit ignore accurate / repeat	1
7(c)(iii)	any **two** from: • different balances used **or** faulty balance • reading / using the balance incorrectly **or** recording error • spilling copper oxide / copper • copper oxide impure • not all of the copper oxide was reduced / converted to copper **or** not enough / different amounts of methane used • heated for different times • heated at different temperatures • some of the copper made is oxidised / forms copper oxide • some of the copper oxide / copper blown out / escapes (from tube) • some water still in the test tube	ignore systematic / human / apparatus / zero / measurement / random / weighing / reading errors unless qualified ignore dirty apparatus accept incorrect weighing of copper / copper oxide allow some copper left in tube allow impure copper (produced) accept not all copper oxide (fully) reacted accept Bunsen burner / flame at different temperatures ignore some copper oxide / copper lost	2
Total			**10**

The AQA UMS Conversion Calculator is available on the Results statistics page of the AQA Website

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
January 2011

Additional Science
Unit Chemistry C2

CHY2F

F

Chemistry
Unit Chemistry C2

Written Paper

Monday 17 January 2011 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

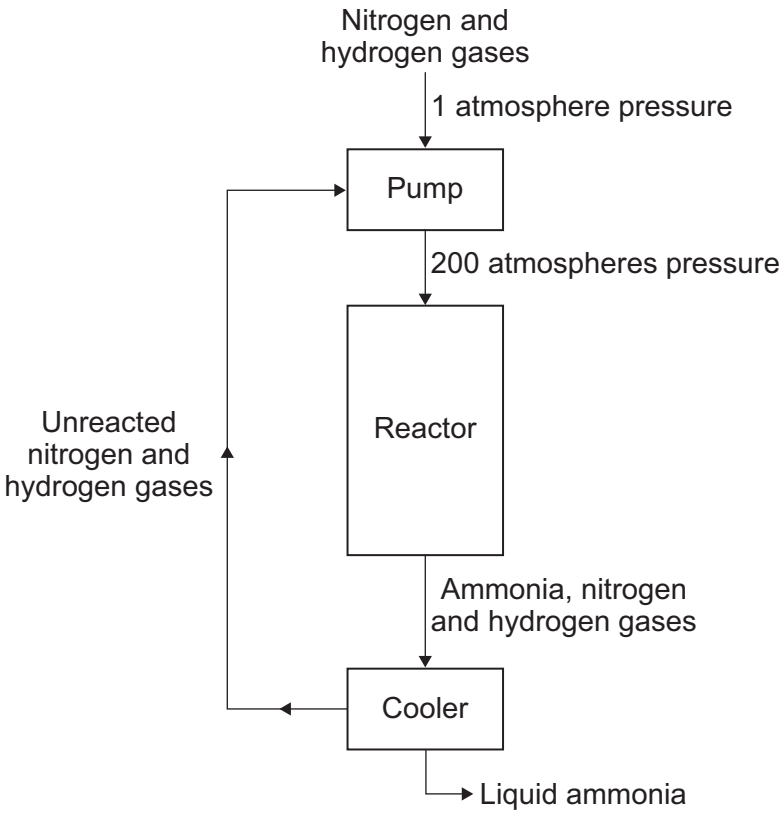
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

Answer **all** questions in the spaces provided.

1 The flow diagram shows how ammonia is made.



1 (a) What effect, if any, does the **pump** have on the pressure of the nitrogen and hydrogen?

Draw a ring around the correct answer to complete the sentence.

The pump | decreases / has no effect on / increases | the pressure.

(1 mark)

Do not write outside the box

1 (b) The word equation for making ammonia is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

In the **reactor** only a small amount of the nitrogen and hydrogen is changed into ammonia.

Tick (✓) the reason why.

Reason why	Tick (✓)
Ammonia is formed from two elements.	
Nitrogen and hydrogen are gases.	
The reaction is reversible.	

(1 mark)

1 (c) In the **cooler** the mixture of gases is cooled.

Draw a ring around the correct answer to complete the sentence.

The cooler turns the ammonia into

a liquid.

a solid.

an element.

(1 mark)

1 (d) What happens to the unreacted nitrogen and hydrogen from the **reactor**?

.....

.....

(1 mark)

4

Turn over for the next question

Do not write outside the box

2 The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.



The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

I use different coloured dyes dissolved in methanol. I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time. The bowl dries more quickly if I use methanol instead of water.

2 (a) The artist uses methanol instead of water.

Give **two** reasons why.

1 .....

.....

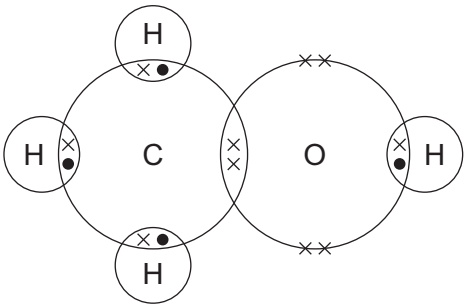
2 .....

.....

(2 marks)

Do not write outside the box

2 (b) The diagram shows how the atoms are bonded in methanol.



Draw a ring around:

2 (b) (i) the formula of methanol

CH_4O **CH^4O** **CHO_4**

(1 mark)

2 (b) (ii) the type of bonding in methanol.

covalent **ionic** **metallic**

(1 mark)

2 (c) Methanol has a low boiling point.

Tick (✓) the reason why.

Reason why	Tick (✓)
It has a giant covalent structure.	
It is made of small molecules.	
It has a giant metallic structure.	

(1 mark)

5

Turn over for the next question

Do not write outside the box

3 (a) A magnesium atom contains 12 protons (•),12 neutrons (o) and 12 electrons (×).

Which diagram, **A**, **B** or **C**, represents this magnesium atom?

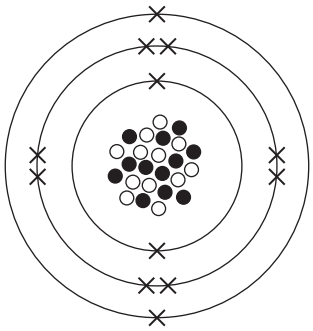


Diagram A

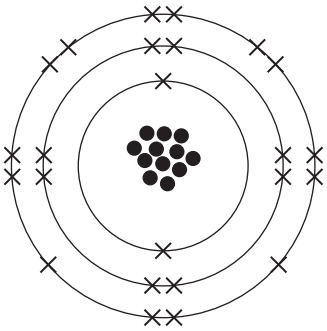


Diagram B

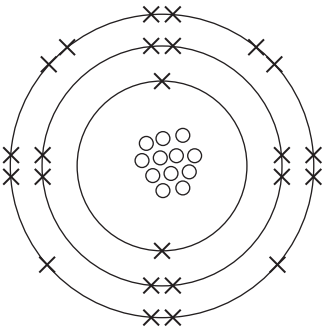
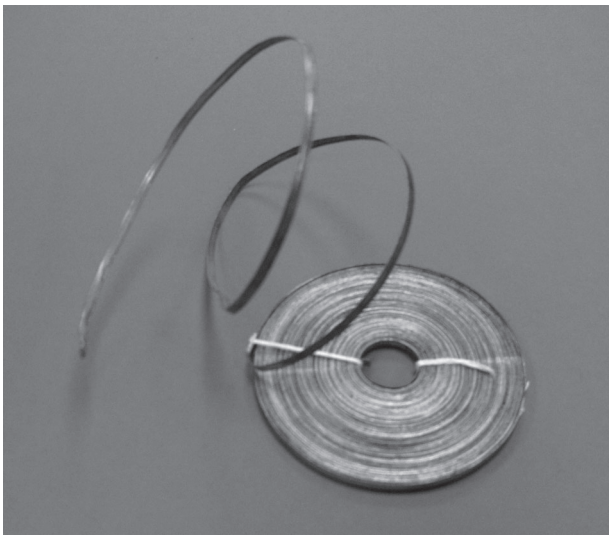


Diagram C

This magnesium atom is **Diagram** ☐ .

(1 mark)

3 (b) Magnesium metal is shaped to make magnesium ribbon.



Tick (✓) **two** reasons which explain why metals can be shaped.

Reason why	Tick (✓)
The atoms are all joined by covalent bonds.	
The atoms can slide over each other.	
The atoms are large.	
The atoms are in layers.	

(2 marks)

Do not write outside the box

3 (c) Magnesium sulfate is a salt of magnesium.

It can be prepared by the reaction of magnesium metal with an acid. The equation for the reaction of magnesium with this acid is:

Mg(s)	+	H_2SO_4(aq)	→	$MgSO_4$(aq)	+	H_2(g)
magnesium		acid		magnesium sulfate solution		hydrogen

3 (c) (i) Draw a ring around the name of the acid used in this reaction.

hydrochloric **nitric** **sulfuric**

(1 mark)

3 (c) (ii) Use the equation to help you to answer this question.

Tick (✓) **two** things that happen when this reaction takes place.

	Tick (✓)
Bubbles are produced.	
The magnesium disappears.	
A solid is formed.	
Water is formed.	

(2 marks)

3 (c) (iii) Draw a ring around a method to get solid magnesium sulfate from magnesium sulfate solution.

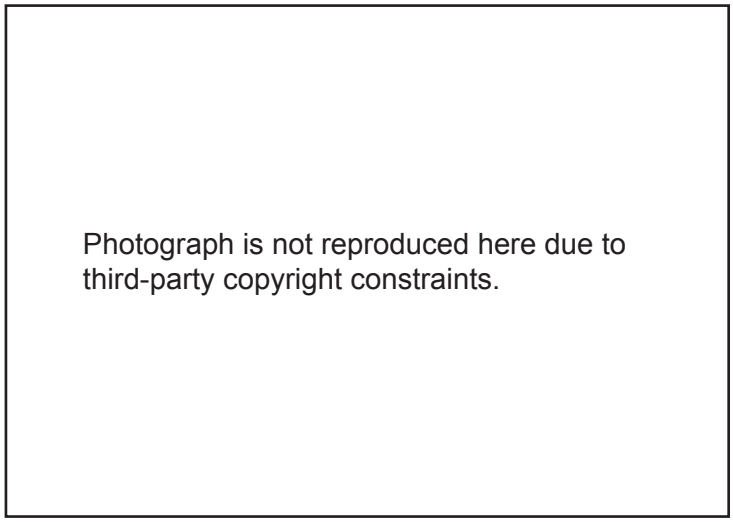
crystallisation **electrolysis** **oxidation**

(1 mark)

7

Do not write outside the box

4 Welding blankets are placed under metals being welded. They protect the area under the welding from hot sparks or molten metal.



Some welding blankets are made from silicon dioxide.

4 (a) The table lists some properties of materials.

Two of these are properties of materials used to make welding blankets.

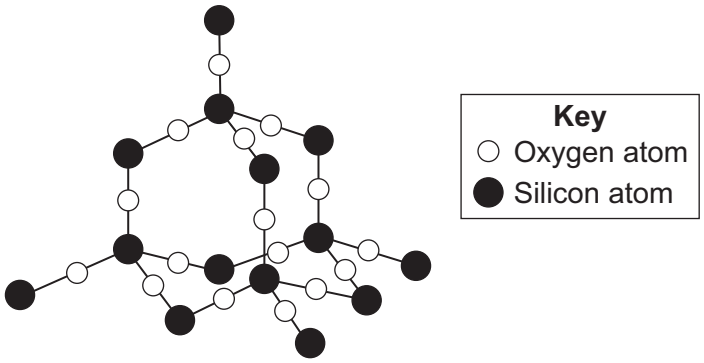
Tick (✓) the **two** correct properties.

Property	Tick (✓)
High melting point	
Reacts with sparks	
Not flammable	
Low boiling point	

(2 marks)

Do not write outside the box

4 (b) Silicon dioxide has a giant structure. The diagram shows a small part of this structure.



Draw a ring around the correct answer to complete each sentence.

4 (b) (i) Silicon dioxide has a high melting point because [a few / some / all] of the atoms are joined to other atoms.

(1 mark)

4 (b) (ii) Each oxygen atom is joined to [two / three / four] silicon atoms.

(1 mark)

4 (b) (iii) The bonds between the atoms are [covalent. / ionic. / metallic.]

(1 mark)

4 (b) (iv) These bonds are [easily broken. / very strong. / weak.]

(1 mark)

6

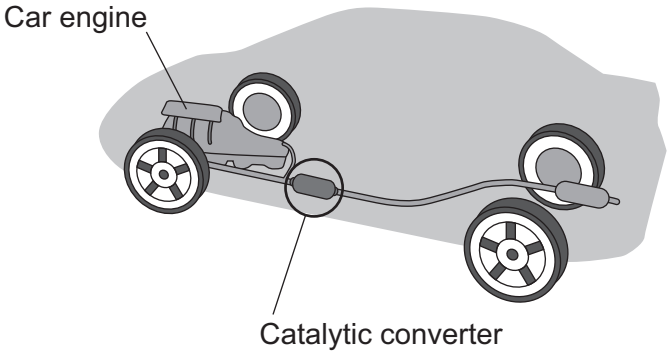
Do not write outside the box

5 Read the information about car engines.

Burning petrol in air is an exothermic reaction. This reaction is used in car engines.

When petrol burns it produces harmful substances such as nitrogen oxides and carbon monoxide.

A catalytic converter stops these harmful substances being released into the air.



5 (a) Draw a ring around the correct answer to complete each sentence.

5 (a) (i) The exothermic reaction makes the temperature of the engine

decrease.

increase.

stay the same.

(1 mark)

5 (a) (ii) This is because during exothermic reactions

energy is taken in from the surroundings.

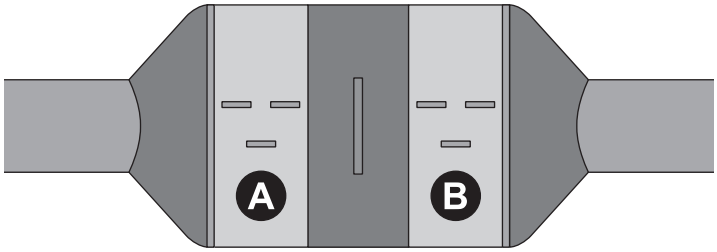
energy is given out to the surroundings.

there is no energy change.

(1 mark)

Do not write outside the box

5 (b) The diagram shows a catalytic converter which removes harmful substances.
The catalytic converter has two parts, **A** and **B**, which contain different catalysts.



5 (b) (i) The equation for the reaction that takes place in part **A** is:

$$2NO \rightarrow N_2 + O_2$$

Which **one** of the substances shown in the equation is a compound?

Give the formula of this compound.

.....

(1 mark)

5 (b) (ii) The equation for the reaction that takes place in part **B** is:

$$2CO + O_2 \rightarrow 2CO_2$$

Why is it important to stop carbon monoxide (CO) from being released into the air?

.....

.....

(1 mark)

5 (c) The table lists some statements about catalysts. Only **two** statements are correct.

Tick (✓) the **two** correct statements.

Statement	Tick (✓)
A catalyst can speed up a chemical reaction.	
A catalyst is used up in a chemical reaction.	
Different reactions need different catalysts.	
A catalyst does **not** change the rate of a chemical reaction.	

(2 marks)

Turn over ▶

Do not write outside the box

5 (d) Modern catalytic converters contain nanosized particles of catalyst.
Less catalyst is needed when nanosized catalyst particles are used.

5 (d) (i) Complete the sentence.

The size of nanosized particles is ..... than normal sized particles.
(1 mark)

5 (d) (ii) The catalysts contain platinum.

Suggest why a manufacturer of catalytic converters would want to use less catalyst.

.....

.....
(1 mark)

8

Do not write outside the box

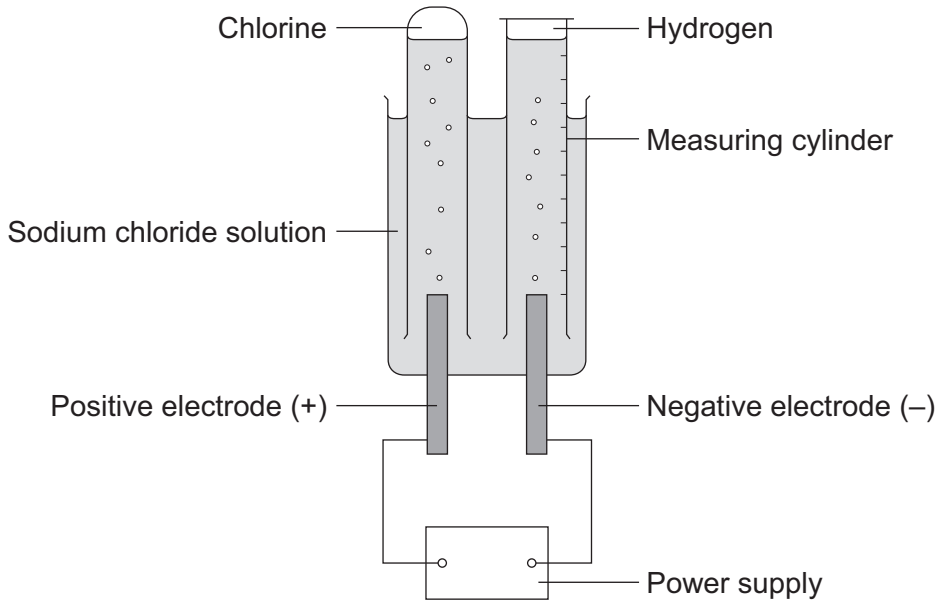
6 A student investigated the electrolysis of sodium chloride solution.

Five sodium chloride solutions were made. Each solution had a different concentration.

To make each solution the student:

- weighed the amount of sodium chloride needed
- dissolved it in water
- added more water until the total volume was one cubic decimetre (1 dm^3).

The solutions were placed one at a time in the apparatus shown below.



The student measured the volume of hydrogen gas produced in ten minutes.

The results are shown on the graph on the next page.

6 (a) Sodium chloride does not conduct electricity when it is solid.

Explain, in terms of ions, why sodium chloride solution conducts electricity.

.....

.....

(1 mark)

6 (b) Chlorine is produced at the positive electrode.

Why are chloride ions attracted to the positive electrode?

.....

(1 mark)

Question 6 continues on the next page

Turn over ▶

Do not write outside the box

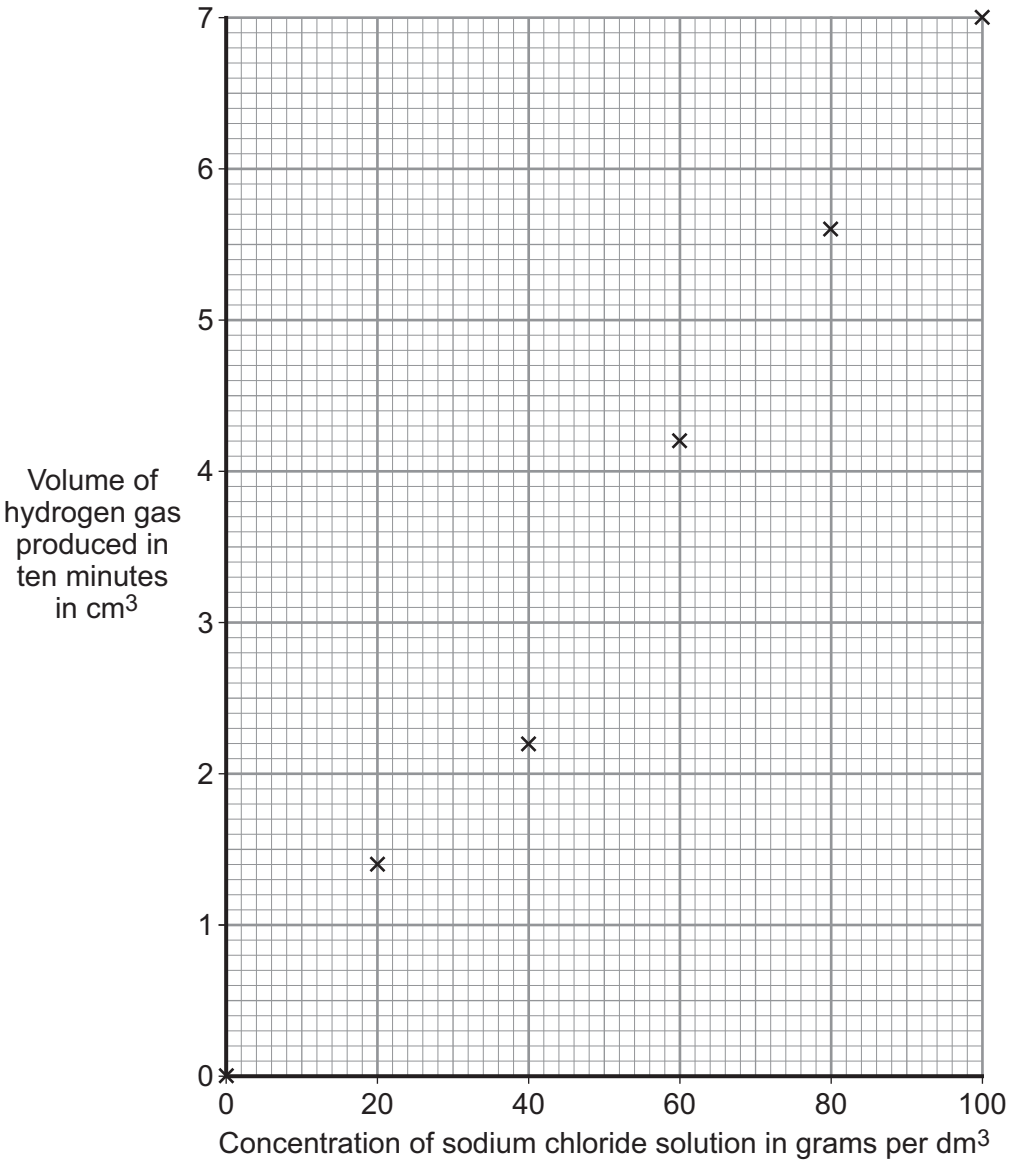
6 (c) The solution left at the end of each experiment contains sodium hydroxide.

Draw a ring around **one** number which could be the pH of this solution.

2 **5** **7** **13**

(1 mark)

6 (d) The results for the experiment on the previous page are shown on the graph.



Do not write outside the box

6 (d) (i) Draw a line of best fit on the graph.

(1 mark)

6 (d) (ii) The result for one concentration is anomalous.
Which result is anomalous?

The result at concentration ..... grams per dm^3

(1 mark)

6 (d) (iii) Suggest **two** possible causes of this anomalous result.

1 .....

.....

2 .....

.....

(2 marks)

6 (d) (iv) Suggest how the student could check the reliability of the results.

.....

.....

(1 mark)

6 (d) (v) How did an increase in the concentration of the sodium chloride solution affect the volume of hydrogen gas produced in ten minutes?

.....

.....

(1 mark)

9

Turn over for the next question

Do not write outside the box

7 Calamine lotion is used to treat itching. The main ingredients are two metal oxides.



7 (a) One of the metal oxides has a relative formula mass (M_r) of 81.

The formula of this metal oxide is MO.
(M is **not** the correct symbol for the metal.)

The relative atomic mass (A_r) of oxygen is 16.

7 (a) (i) Calculate the relative atomic mass (A_r) of metal M.

.....

.....

.....

Relative atomic mass (A_r) = ...
(2 marks)

7 (a) (ii) Use your answer to part (a)(i) and the periodic table on the Data Sheet to name metal M.

The name of metal M is ..... .
(1 mark)

Do not write outside the box

7 (b) The other metal oxide is iron(III) oxide.

This contains iron(III) ions (Fe^{3+}) and oxide ions (O^{2-}).

7 (b) (i) Explain in terms of electrons how an iron atom (Fe) can change into an iron(III) ion (Fe^{3+}).

.....

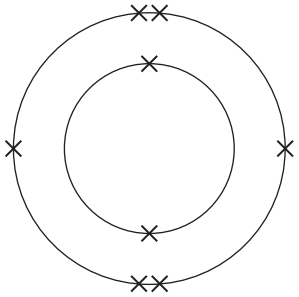
.....

.....

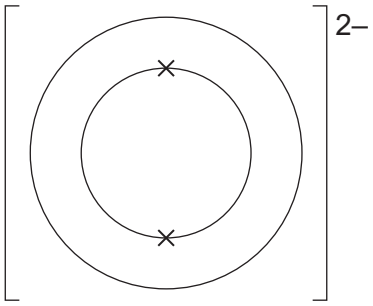
.....

(2 marks)

7 (b) (ii) The diagram below represents the electronic structure of an oxygen atom (O).



Complete the diagram below to show the electronic structure of an oxide ion (O^{2-}).



(1 mark)

6

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Version : 08/03/2011

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2011 examination – January series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)	increases		1
1(b)	the reaction is reversible		1
1(c)	A liquid		1
1(d)	recycled / reused (owtte)	accept returned to pump / start	1
Total			**4**

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CHY2F
Question 2

question	answers	extra information	mark
2(a)	any **two** from • shorter / quicker soaking time • takes less time / quicker to dry **or** faster evaporation • dissolves quicker / better in methanol	assume it = methanol allow converse for water allow it is quicker	2
2(b)(i)	CH_4O		1
2(b)(ii)	covalent		1
2(c)	it is made of small molecules		1
Total			**5**

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CHY2F
Question 3

question	answers	extra information	mark
3(a)	diagram **A**		1
3(b)	the atoms can slide over each other. the atoms are in layers		1 1
3(c)(i)	sulfuric		1
3(c)(ii)	bubbles are produced the magnesium disappears		1 1
3(c)(iii)	crystallisation		1
Total			**7**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	high melting point not flammable		1 1
4(b)(i)	all		1
4(b)(ii)	two		1
4(b)(iii)	covalent		1
4(b)(iv)	very strong		1
Total			**6**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	increase		1
5(a)(ii)	energy is given out to the surroundings		1
5(b)(i)	NO	allow 2NO ignore nitrogen oxide do **not** allow equations	1
5(b)(ii)	harmful / poisonous (owtte)	allow dangerous ignore reference to pollution / global warming do **not** accept references to ozone layer	1
5(c)	a catalyst can speed up a chemical reaction different reactions need different catalysts		1 1
5(d)(i)	smaller	accept less / tiny / very small allow 10^{-9} do **not** allow small unless qualified	1
5(d)(ii)	reduce cost (owtte) **or** save resources / raw materials (owtte)	ignore references to energy	1
Total			**8**

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CHY2F

Question 6

question	answers	extra information	mark
6(a)	the ions can <u>move</u> / <u>travel</u> / <u>flow</u> / are <u>free</u> **or** the ions <u>carry</u> the charge / current	accept particles / they for ions allow delocalised ions ignore delocalised / free electrons ignore references to collisions accept converse with reference to solid ignore ions carry electricity	1
6(b)	any **one** from: • because they are negative / anion • opposite charges / attract	allow Cl^- ignore chlorine	1
6(c)	13		1
6(d)(i)	reasonable attempt at straight line which misses the anomalous point	must touch all five crosses do **not** allow multiple lines	1
6(d)(ii)	40	ignore 2.2	1

Question 6 continues on the next page

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CHY2F

Question 6

question	answers	extra information	mark
6(d)(iii)	any **two** sensible errors from: • gas escapes • weighing error • error in measuring (volume / amount) of hydrogen • error in measuring (volume / amount) of water • incorrect concentration • timing error • change in voltage / current • change in temperature • recording / plotting error	ignore systematic / human / apparatus / zero /experimental / random / measurement / reading errors unless qualified allow NaCl not measured correctly allow error in measuring volume / scale for **1** mark if neither hydrogen or water mentioned allow NaCl not fully dissolved **or** spilled **or** impure allow faulty power supply	2
6(d)(iv)	any **one** from: • repeat the experiment • results compared with results from /other students / other groups / other laboratories / internet / literature. • results compared with another method	ignore 'do more tests'	1
6(d)(v)	increases owtte	allow directly proportional or positive correlation allow rate / it is faster / quicker	1
Total			**9**

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CHY2F

Question 7

question	answers	extra information	mark
7(a)(i)	65	correct answer with or without working = **2** marks if answer incorrect evidence of (81 – 16) for **1** mark ignore units	2
7(a)(ii)	zinc	accept error carried forward from (a)(i) allow correct symbol answer given should be element / metal closest to their answer do **not** allow compounds	1
7(b)(i)	• it loses electrons • three electrons	sharing / covalency = max **1** mark	1 1
7(b)(ii)	8 electrons shown in second shell.	accept dots / crosses / mixture of dots and crosses / e electrons do not need to be paired do **not** allow extra electrons in first shell	1
Total			**6**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2010

Additional Science
Unit Chemistry C2

CHY2F

F

Chemistry
Unit Chemistry C2

Wednesday 26 May 2010 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

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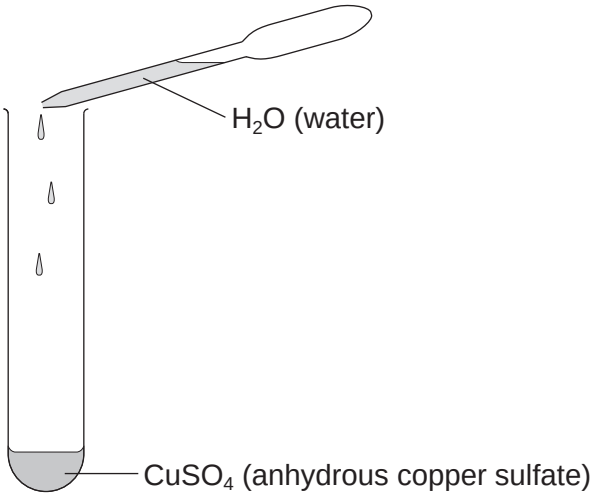
There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Answer **all** questions in the spaces provided.

1 The diagram shows how anhydrous copper sulfate can be used to test for water.



$$\underset{\text{white}}{CuSO_4} + \underset{\text{colourless}}{5H_2O} \rightleftharpoons \underset{\text{blue}}{CuSO_4.\,5H_2O}$$

1 (a) What colour change will you see when water is added to the $CuSO_4$?

Colour changes from .....to .....

(1 mark)

1 (b) Draw a ring around the meaning of the symbol $\rightleftharpoons$

endothermic **exothermic** **reversible**

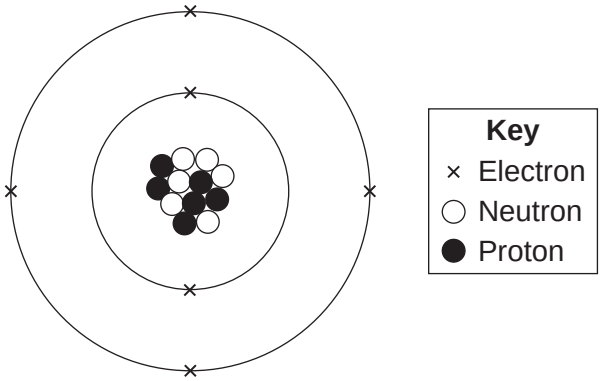
(1 mark)

2

Turn over for the next question

Do not write outside the box

2 The diagram represents a carbon atom.



2 (a) Use words from the box to answer the questions.

electron	**neutron**	**nucleus**	**proton**

2 (a) (i) What is the name of the central part of the atom?

.....

(1 mark)

2 (a) (ii) What is the name of the particle with no charge?

.....

(1 mark)

2 (a) (iii) What is the name of the particle with a negative charge?

.....

(1 mark)

2 (b) Use the diagram above to help you to answer these questions.

2 (b) (i) Draw a ring around the atomic (proton) number of this carbon atom.

6 **12** **18**

(1 mark)

2 (b) (ii) Draw a ring around the mass number of this carbon atom.

6 **12** **18**

(1 mark)

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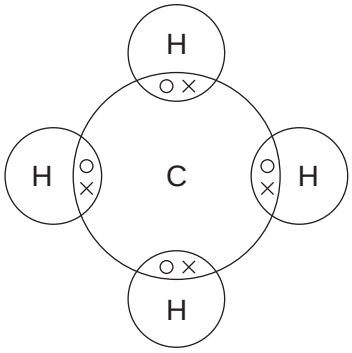
2 (c) A different carbon atom has 6 protons and 8 neutrons.

Draw a ring around the symbol that represents this atom.

$^{8}_{6}C$ $^{14}_{6}C$ $^{14}_{8}C$

(1 mark)

2 (d) The diagram shows the bonding in a methane molecule.



2 (d) (i) Draw a ring around the chemical formula of a methane molecule.

CH_4 **CH^4** **C_4H**

(1 mark)

2 (d) (ii) Draw a ring around the word that describes methane.

compound **element** **mixture**

(1 mark)

2 (d) (iii) Draw a ring around the type of bonding in a methane molecule.

covalent **ionic** **metallic**

(1 mark)

9

Turn over for the next question

Do not write outside the box

3 The picture shows a student with two glow sticks.



Glow sticks contain several chemicals. When a glow stick is bent the chemicals mix. A chemical reaction takes place which causes light to be given out.

A student investigated three glow sticks. One was placed in water at 5 ºC, one in water at 40 ºC and one in water at 70 ºC.

The results are shown in the table.

Temperature in ºC	Effect on glow stick	
	Brightness of light	Time it gave out light, in hours
5	dim	7
40	bright	3
70	very bright	1

3 (a) How did increasing the temperature affect the brightness of the glow stick?

.....

.....

(1 mark)

3 (b) How did increasing the temperature affect the time it gave out light?

.....

.....

(1 mark)

Do not write outside the box

3 (c) The student was asked why an **increase** in temperature changes the rate of the chemical reaction. The student listed five ideas. Only **three** of them are correct.

Put ticks (✓) next to the **three** correct ideas.

Ideas	Tick (✓)
The particles will collide more often.	
The particles will be more concentrated.	
The particles will move faster.	
The particles will have more energy.	
The particles will get bigger.	

(3 marks)

3 (d) Suggest **one** way the student could improve this investigation.

.....

.....

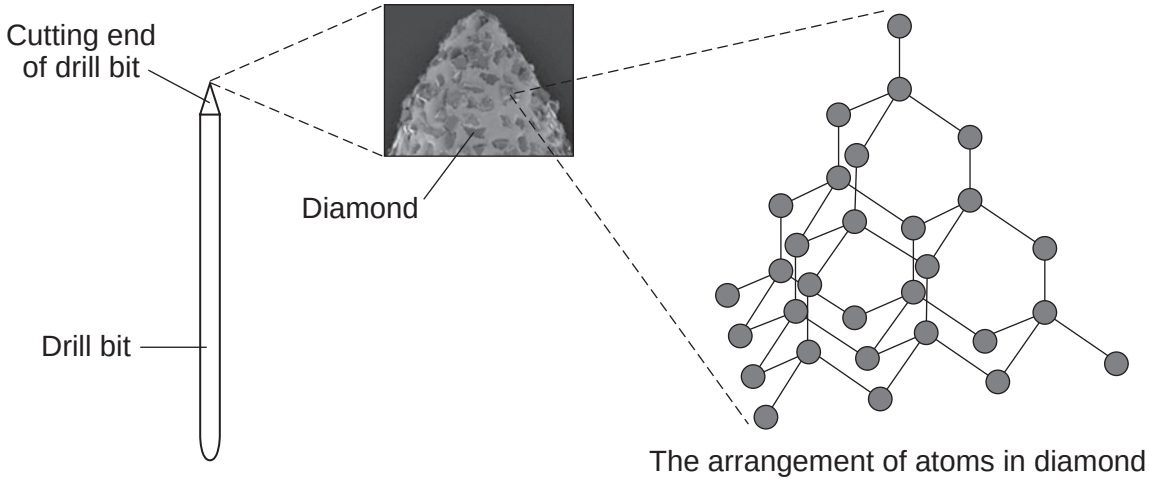
(1 mark)

6

Turn over for the next question

Do not write outside the box

4 A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



The arrangement of atoms in diamond

Draw a ring around the correct word in each box.

4 (a) Diamond is made from [carbon / nitrogen / oxygen] atoms.

(1 mark)

4 (b) Diamond has a giant structure in which [none / some / all] of the atoms are joined together.

(1 mark)

4 (c) The atoms in diamond are joined together by [covalent / ionic / metallic] bonds.

(1 mark)

Do not write outside the box

4 (d) In diamond each atom is joined to

two
three
four

other atoms.

(1 mark)

4 (e) Diamond is suitable for the cutting end of a drill bit because it is

hard.
shiny.
soft.

(1 mark)

5

Turn over for the next question

Do not write outside the box

5 This question is about lead iodide and magnesium iodide.

5 (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a solid.

lead ions in solution + iodide ions in solution → lead iodide solid

5 (a) (i) Draw a ring around the name given to this type of reaction.

electrolysis **neutralisation** **precipitation**

(1 mark)

5 (a) (ii) Tick (✓) the method used to separate solid lead iodide from the solution.

Method	Tick (✓)
distillation	
evaporation	
filtration	

(1 mark)

5 (a) (iii) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you to:

draw a ring around a soluble compound which contains lead ions

lead bromide **lead chloride** **lead nitrate**

draw a ring around a soluble compound which contains iodide ions.

lead iodide **silver iodide** **sodium iodide**

(2 marks)

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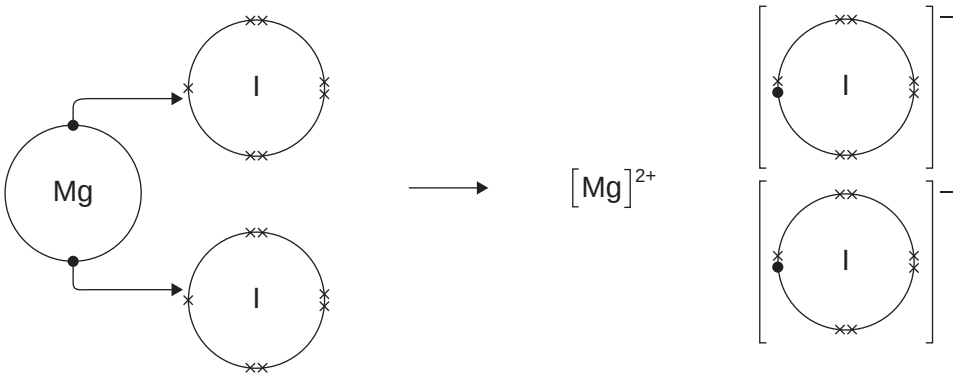
5 (b) Magnesium iodide can be made by reacting magnesium with iodine.

magnesium + iodine → magnesium iodide

The diagram shows how this takes place.

Only the outer electrons are shown.

The dots (•) and crosses (×) are used to represent electrons.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

.....

.....

.....

.....

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.....

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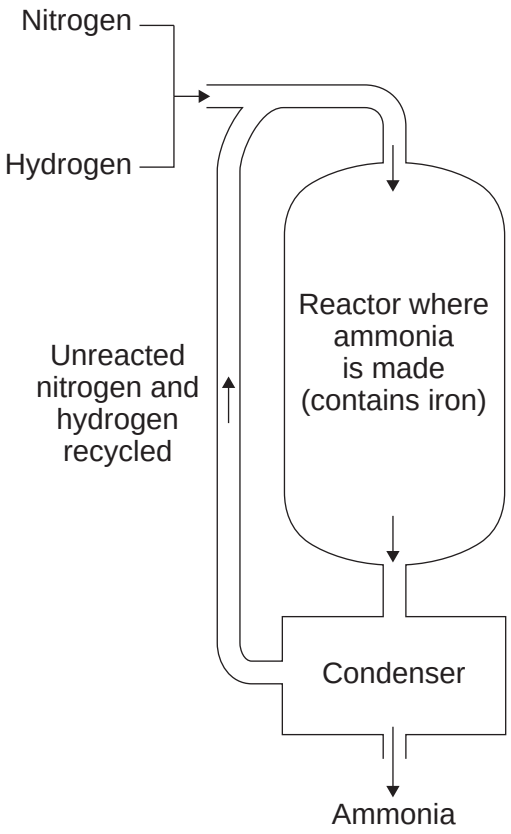
(4 marks)

8

Turn over ▶

Do not write outside the box

6 (a) The diagram shows how ammonia is made.



6 (a) (i) Complete the word equation for the reaction that takes place in the reactor.

nitrogen + ... → .....

(1 mark)

6 (a) (ii) Ammonia is made by passing nitrogen and hydrogen over hot iron.
Why is iron used in the reactor?

.....

.....

(1 mark)

6 (a) (iii) Explain how ammonia is separated from the unreacted nitrogen and hydrogen.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

6 (b) Ammonia is used to make the fertiliser ammonium nitrate.

Calculate the relative formula mass (M_r) of ammonium nitrate, NH_4NO_3

Relative atomic masses (A_r): H = 1; N = 14; O = 16

.....

.....

.....

.....

Relative formula mass = ...

(2 marks)

6 (c) Another fertiliser is potassium nitrate, KNO_3

The relative formula mass (M_r) of potassium nitrate is 101.

Relative atomic masses (A_r): N = 14; O = 16; K = 39

The table shows the percentage by mass of potassium and nitrogen in four fertilisers, **A**, **B**, **C** and **D**.

Fertiliser	Percentage by mass of potassium (%)	Percentage by mass of nitrogen (%)
A	12.45	25.21
B	19.91	24.12
C	38.61	13.86
D	24.89	9.25

Which fertiliser, **A**, **B**, **C** or **D**, is potassium nitrate?

You **must** show your working to gain full marks.

.....

.....

.....

.....

Potassium nitrate is fertiliser ☐

(2 marks)

8

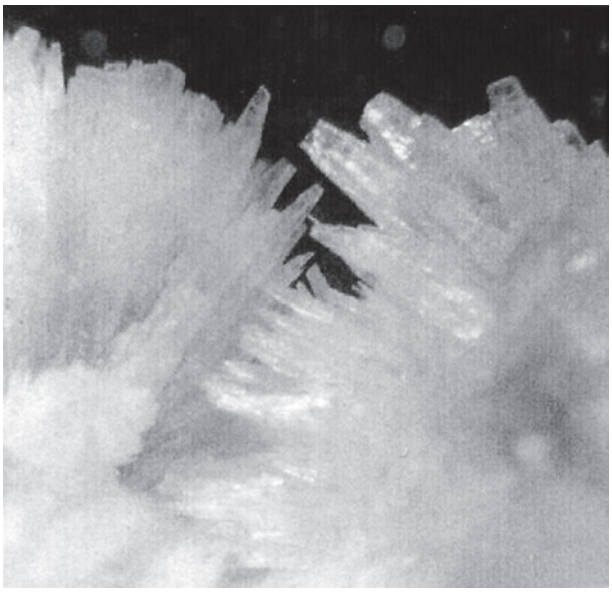
Turn over ▶

Do not write outside the box

7 (a) Read the article about the mineral strontianite.

Strontianite is a mineral that was discovered near the village of Strontian in Scotland. At first some scientists thought that strontianite was barium carbonate.

Strontianite



In 1790, Professor Adair Crawford and William Cruikshank were both lecturers in chemistry and doctors of medicine. They investigated the properties of strontianite. They found that strontianite had different properties from barium carbonate. They concluded that strontianite contained a new element.

After this, other scientists also showed that strontianite and barium carbonate had different properties. Strontianite is now known to be strontium carbonate.

7 (a) (i) What evidence did Crawford and Cruikshank use to prove that strontianite was **not** barium carbonate?

.....

.....

(1 mark)

7 (a) (ii) Crawford and Cruikshank's conclusion was immediately accepted by other scientists. Suggest why.

.....

.....

(1 mark)

7 (a) (iii) How was the reliability of the work of Crawford and Cruikshank confirmed?

.....

.....

(1 mark)

Do not write outside the box

7 (b) One of Crawford and Cruikshank's experiments was repeated in a school laboratory. Samples of strontianite and barium carbonate were reacted with hydrochloric acid to produce strontium chloride and barium chloride.

Solid strontium chloride and solid barium chloride were separately added to water. The change in temperature of the water was measured.

The results of the experiments are shown below.

	Experiment 1 Strontium chloride dissolved in water	**Experiment 2** Barium chloride dissolved in water
Temperature of water before adding the chloride in ºC	19.5	19.6
Temperature of water after adding the chloride in ºC	21.2	17.5

7 (b) (i) State **one** variable that should be controlled to make it a fair test.

.....

.....

(1 mark)

7 (b) (ii) Which experiment, **1** or **2**, is endothermic?

Explain how you know.

Experiment ☐ because .....

.....

(1 mark)

7 (b) (iii) The results prove that strontium chloride and barium chloride must be different even if all of the variables had not been controlled when they were dissolved. Explain why.

.....

.....

(1 mark)

7 (c) In 1808, Humphry Davy was the first person to extract strontium. He did this by the electrolysis of molten strontium chloride. Strontium formed at the negative electrode.

Suggest why strontium ions are attracted to the negative electrode.

.....

.....

(1 mark)

7

END OF QUESTIONS

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Version: 17/08/2010

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2010 Examination – June Series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Marking Guidance for Examiners

GCSE Science Papers

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:

where consequential marking needs to be considered in a calculation;

or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct

substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)	white to blue	accept colourless to blue	1
1(b)	reversible		1
Total			**2**

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CHY2F

Question 2

question	answers	extra information	mark
2(a)(i)	nucleus		1
2(a)(ii)	neutron		1
2(a)(iii)	electron		1
2(b)(i)	6		1
2(b)(ii)	12		1
2(c)	14 C 6		1
2(d)(i)	CH_4		1
2(d)(ii)	compound		1
2(d)(iii)	covalent		1
Total			**9**

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CHY2F

Question 3

question	answers	extra information	mark
3(a)	the glow stick is brighter (owtte)	accept glow stick is less bright **at low temperatures** (owtte) ignore references to rate / particles	1
3(b)	gave out light for less time	accept use of figures from table for comparison allow reference to speed / rate eg quicker / faster reaction	1
3(c)	the particles will collide more often the particles will move faster the particles will have more energy		1 1 1
3(d)	any **one** from: • repeat • measure brightness eg use light meter • more temperatures **or** wider range • improve precision	allow more glow sticks	1
Total			**6**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	carbon		1
4(b)	all		1
4(c)	covalent		1
4(d)	four		1
4(e)	hard		1
Total			**5**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	precipitation		1
5(a)(ii)	filtration		1
5(a)(iii)	lead nitrate sodium iodide		1 1
5(b)	any **four** from: • magnesium (atom) reacts with **two** iodine (atoms) • magnesium (atom) loses • **2** electrons • iodine (atom) gains • **1** electron **or** an electron • iodide ion formed • iodide has negative charge / is a negative ion / particle • magnesium ion formed • magnesium has positive charge • oppositely charged ions attract • a giant structure / lattice is formed	sharing / covalent / metallic = max **3** allow iodine ion allow iodine ignore I^{2-} if reference to ions being formed is made unqualified, allow **1** mark	4
Total			**8**

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CHY2F

Question 6

question	answers	extra information	mark
6(a)(i)	(nitrogen) + hydrogen → ammonia	accept H_2 and NH_3 ignore incorrect symbols ignore balancing	1
6(a)(ii)	any **one** from: • catalyst • to speed up the reaction • lower activation energy	 ignore causes reaction ignore heat / reference to particles 	1
6(a)(iii)	any **two** from: • cooled • ammonia condenses / turns into liquid • nitrogen and hydrogen do not condense / turn into liquid **or** nitrogen and hydrogen stay as gases	it = ammonia ignore references to boiling point if no marks awarded accept pass through / separated in condenser **or** unreacted nitrogen and hydrogen / gases recycled for **1** mark	2

Question 6 continues on the next page

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CHY2F

Question 6 continued

question	answers	extra information	mark
6(b)	80	correct answer with or without working gains **2** marks ignore units if answer incorrect, evidence of correct *working* gains **1** mark eg 14 + (4 x 1) + 14 + (3 x 16) (= 70) **or** 2N + 4H +30	2
6(c)	fertiliser is **C** evidence of correct working	 examples of minimum correct working: 39/101 **or** 14/101 **or** 38.61/100 **or** 13.86/100	1 1
Total			**8**

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CHY2F

Question 7

question	answers	extra information	mark
7(a)(i)	(different) properties	allow ideas of different property / behaviour / element	1
7(a)(ii)	any **one** from: • they had high status **or** they were lecturers / doctors / professors / famous scientists • other scientists repeated experiments • they had proof **or** lots of / strong / conclusive / enough / clear evidence	they = Crawford + Cruikshank allow experiment could be repeated allow other scientists showed they had different properties ignore evidence unqualified	1
7(a)(iii)	other scientists obtained similar results / proved it **or** experiments were repeated		1

Question 7 continues on the next page

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CHY2F

Question 7 continued

question	answers	extra information	mark
7(b)(i)	any **one** from: • mass of solid / strontium (chloride) / barium (chloride) • volume of water • type of container	allow amount / volume allow amount / mass allow initial / starting temperature (of water) ignore room temperature / time / concentration ignore reference to hydrochloric acid	1
7(b)(ii)	2 **and** takes in heat / energy **or** 2 **and** temperature goes down (owtte)		1
7(b)(iii)	temperature increased for one experiment and decreased for the other (owtte) **or** one was exothermic and one was endothermic (owtte)	accept experiment 1 was exothermic	1
7(c)	any **one** from • positive / + (charge) • opposite (charges) attract	do **not** accept incorrect further qualification eg electrons / atoms / electrodes	1
Total			**7**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



General Certificate of Secondary Education
Foundation Tier
January 2010

Additional Science
Unit Chemistry C2

CHY2F

F

Chemistry
Unit Chemistry C2

Written Paper

Monday 18 January 2010 9.00 am to 9.45 am

For this paper you must have:
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.



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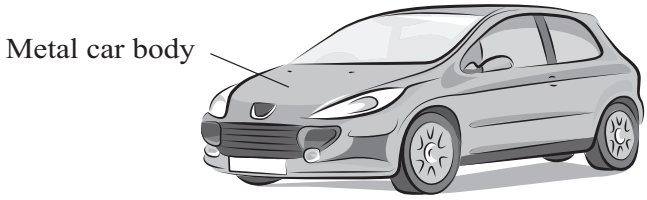
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ANSWER IN THE SPACES PROVIDED

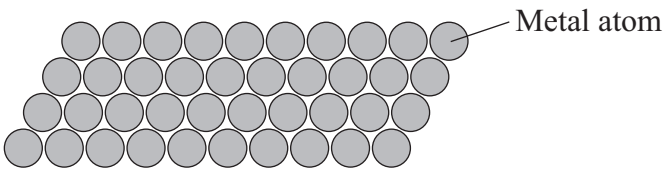
Areas outside the box will not be scanned for marking

Answer **all** questions in the spaces provided.

1 Metal is bent and shaped to make a car body.



The diagram below represents how atoms are arranged in a metal.



Which **two** statements in the table best explain why the metal can be bent and shaped?

Tick (✓) the **two** statements.

Statement	Tick (✓)
The atoms are in layers.	
The metal is shiny.	
The atoms can slide over each other.	
All the atoms are linked by strong covalent bonds.	

(2 marks)

2

Areas outside the box will not be scanned for marking

2 Ammonium salts are used to help farmers grow crops.



2 (a) Use the correct word from the box to complete the sentence.

fertilisers	**insecticides**	**pesticides**

Ammonium salts contain nitrogen and are used by farmers as ..... to replace the nitrogen lost from the soil.

(1 mark)

2 (b) Ammonia is made by reacting nitrogen with hydrogen.

Draw a ring around the name of the raw material that provides the nitrogen.

air **crude oil** **water**

(1 mark)

2 (c) Methane and water react together to form the hydrogen.

methane and water → reactor containing a catalyst → hydrogen and carbon monoxide

2 (c) (i) Complete the word equation for this reaction.

methane + ... → hydrogen + ...

(1 mark)

Areas outside the box will not be scanned for marking

2 (c) (ii) How does the catalyst help this reaction?

.....

.....

(1 mark)

2 (d) The reaction between nitrogen and hydrogen to make ammonia can be represented by this equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Draw a ring around the meaning of the symbol, $\rightleftharpoons$

endothermic reaction **precipitation reaction** **reversible reaction**

(1 mark)

2 (e) A solution of ammonia in water is alkaline.

2 (e) (i) Which **one** of these values could be the pH of this ammonia solution?

Draw a ring around your answer.

4 **7** **10**

(1 mark)

2 (e) (ii) The ammonium salt called ammonium sulfate can be made by reacting ammonia solution with an acid.

Use the correct words from the box to complete the sentences.

hydrochloric	**hydrogen**	**sulfuric**	**water**

Ammonia solution is reacted with ..... acid to make ammonium sulfate.

During the reaction the hydrogen ions from the acid react with hydroxide ions from the alkali to make..... .

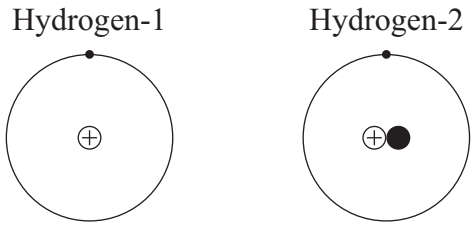
(2 marks)

8

Areas outside the box will not be scanned for marking

3 Two isotopes of hydrogen are hydrogen-1 ($^{1}_{1}H$) and hydrogen-2 ($^{2}_{1}H$).

The diagrams represent atoms of hydrogen-1 and hydrogen-2.



3 (a) Use the correct words from the box to complete the sentences.

electrons	**neutrons**	**protons**

3 (a) (i) The positive particles , ⊕ , in the nucleus of atoms are called

..... .

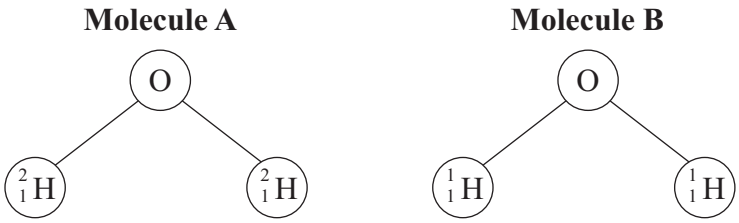
(1 mark)

3 (a) (ii) The particles with no charge, ● , in the nucleus of atoms are called

..... .

(1 mark)

3 (b) The diagrams show two different types of water molecule.



Draw a ring around the correct answer to complete the sentence.

Molecule **A** is

heavier than

lighter than

the same mass as

molecule **B**.

Explain your answer.

.....

.....

(2 marks)

4

Turn over for the next question

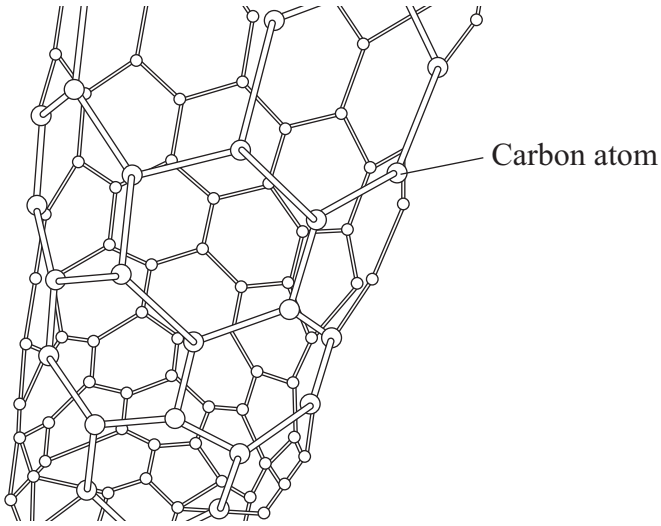
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Areas outside the box will not be scanned for marking

4 Lightweight handlebars for bicycles are made from materials containing carbon nanotubes.

Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



4 (a) What does the term 'nano' tell you about the diameter of carbon nanotubes?

Tick (✓) the correct answer in the table.

Answer	**Tick (✓)**
The diameter of the tube is very small.	
The diameter of the tube is large.	
The diameter of the tube is very large	

(1 mark)

Areas outside the box will not be scanned for marking

4 (b) Look at the diagram and then draw a ring around the correct word to complete each sentence.

4 (b) (i) Carbon nanotubes are similar to graphite because each carbon atom is joined to

two
three
four

other carbon atoms.

(1 mark)

4 (b) (ii) The carbon atoms are joined by

covalent
ionic
metallic

bonds.

(1 mark)

4 (b) (iii) Carbon nanotubes are very strong because the

atoms
bonds
electrons

are hard to break.

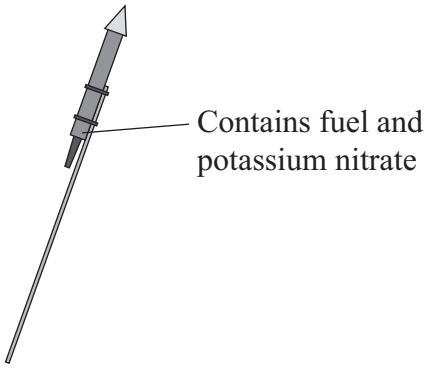
(1 mark)

4

Turn over for the next question

Areas outside the box will not be scanned for marking

5 Firework rockets contain fuel and potassium nitrate.



The potassium nitrate provides oxygen for the fuel to react.

5 (a) The table shows how a student worked out the relative formula mass (M_r) of potassium nitrate.

Some of the numbers are missing.

Relative atomic masses (A_r): N = 14; O = 16; K = 39.

Name of atom (symbol)	**Number of atoms**	A_r	**Mass**
potassium (K)	1	39	39
nitrogen (N)	1	14	14
oxygen (O)		16	
		The M_r of potassium nitrate =	101

5 (a) (i) The mass of oxygen is not shown in the table.

Draw a ring around the correct mass of oxygen.

16 **32** **48**

(1 mark)

5 (a) (ii) Draw a ring around the number of oxygen atoms in the formula of potassium nitrate.

1 **2** **3**

(1 mark)

Areas outside the box will not be scanned for marking

5 (b) When the fuel reacts with the oxygen an *exothermic* reaction takes place.

What does *exothermic* mean?

.....

.....

.....

.....

(2 marks)

5 (c) The fuel contains carbon. Carbon reacts with oxygen to make carbon dioxide.

Which **two** statements in the table explain why carbon dioxide is a gas at room temperature?

Tick (✓) the **two** statements.

Statement	**Tick (✓)**
It has a giant structure	
It has a low boiling point.	
It is made of small molecules.	
It is made of ions.	

(2 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

6 Hydrogen fluoride is used to make hydrofluoric acid.

6 (a) A company makes hydrogen fluoride by reacting solid calcium fluoride with sulfuric acid. The reaction takes place in a rotating kiln.

calcium fluoride + sulfuric acid → calcium sulfate + hydrogen fluoride

The company want this reaction to take place quickly.

6 (a) (i) Rotating the kiln makes the reaction take place faster.

Suggest why.

.....

.....

(1 mark)

6 (a) (ii) Draw a ring around the correct word in each box.

To make the reaction take place **faster**:

the temperature should be [higher / lower] so that the particles have [less / more] energy

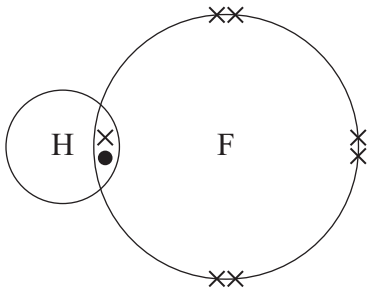
the solid calcium fluoride should be [powder / lumps] to give a [small / big] surface area

the sulfuric acid solution should be [dilute / concentrated] to give [less / more] collisions between the particles each second.

(3 marks)

Areas outside the box will not be scanned for marking

6 (b) The diagram represents a molecule of hydrogen fluoride.



The hydrogen and fluorine atoms are joined by a covalent bond.

Use the correct word from the box to complete the sentence.

electrons	**neutrons**	**protons**

In a covalent bond the atoms share ..... .

(1 mark)

6 (c) Hydrogen fluoride is dissolved in water to make an acidic solution of hydrofluoric acid.

Draw a ring around the symbol of the ion that makes the solution acidic.

H^+ **OH^-** **F^-**

(1 mark)

6

Turn over for the next question

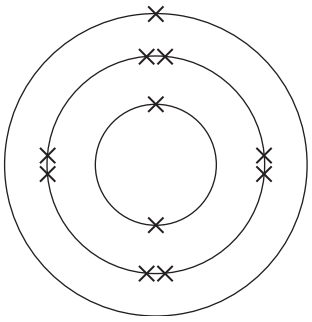
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7 Sodium chloride is a raw material.

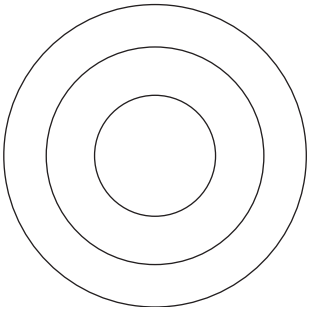
7 (a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

Sodium atom



Chlorine atom



(1 mark)

7 (b) When sodium and chlorine react to form sodium chloride they form sodium ions (Na^+) and chloride ions (Cl^-).

How does a sodium atom change into a sodium ion?

.....

.....

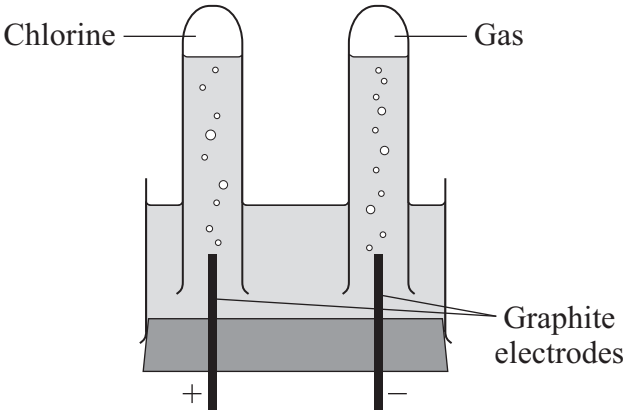
.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

7 (c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions (Na^+), chloride ions (Cl^-), hydrogen ions (H^+) and hydroxide ions (OH^-).

7 (c) (i) Why do chloride ions move to the positive electrode?

.....

(1 mark)

7 (c) (ii) Name the gas formed at the negative electrode.

.....

(1 mark)

Question 7 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

7 (d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

> Local people have been protesting outside a paper factory. They say:
> 'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'
>
> The company replied:
> 'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

7 (d) (i) Why are some local people worried about the use of chlorine compounds?

.....

.....

(1 mark)

7 (d) (ii) Why might other local people want the company to continue to use chlorine compounds?

.....

.....

(1 mark)

7 (d) (iii) It is decided to have an enquiry.
Why should this be done by independent scientists?

.....

.....

(1 mark)

8

Turn over for the next question

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8 Read the article.

In the late eighteenth century the French scientist Nicolas Leblanc invented a process to change sodium chloride into sodium carbonate.

The main steps in the original process were:

Step 1. Sodium chloride was reacted with sulfuric acid to make sodium sulfate. Hydrogen chloride was formed and escaped into the atmosphere. The hydrogen chloride damaged plants over a wide area around the factory.

Step 2. The sodium sulfate was heated with limestone and coal. A solid mixture was formed which contained sodium carbonate, calcium sulfide and unreacted coal. The calcium sulfide gave off a very unpleasant smell.

Step 3. The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

Step 4. Crystals of sodium carbonate were obtained from the solution of sodium carbonate.

The process was later improved.

- The hydrogen chloride produced in **Step 1** was changed into chlorine which was used to make bleach.
- The calcium sulfide produced in **Step 2** was converted into sulfur. This sulfur was used to make sulfuric acid.

8 (a) The symbol equation for the reaction in **Step 1** is shown below.

$$2NaCl(s) + H_2SO_4(l) \rightarrow Na_2SO_4(s) + 2HCl(g)$$

What property of hydrogen chloride allowed it to escape into the atmosphere?

.....

(1 mark)

Areas outside the box will not be scanned for marking

8 (b) The insoluble solids, calcium sulfide and unreacted coal were separated from the sodium carbonate solution in **Step 3**.

Suggest how this was done.

.....

.....

(1 mark)

8 (c) Sodium carbonate crystals were obtained from sodium carbonate solution in **Step 4**.

Suggest how this was done.

.....

.....

(1 mark)

8 (d) It has been stated that: 'the Chemical Industry can turn problems into profit'.

State **two** problems with the original process and explain how they were turned into profit.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

(4 marks)

7

END OF QUESTIONS

There are no questions printed on this page

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Version : 09/03/2010

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2010 examination – January series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1	the atoms are in layers the atoms can slide over each other		1 1
Total			**2**

Question 2

question	answers	extra information	mark
2(a)	fertilisers		1
2(b)	air		1
2(c)(i)	water **and** carbon monoxide on correct side of equation	accept H_2O for water and CO for carbon monoxide	1
2(c)(ii)	speeds up the reaction (owtte)	accept lowers the activation energy	1
2(d)	reversible reaction		1
2(e)(i)	10		1
2(e)(ii)	sulfuric water	accept H_2SO_4 accept H_2O / hydrogen oxide	1 1
Total			**8**

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CHY2F

Question 3

question	answers	extra information	mark
3(a)(i)	protons		1
3(a)(ii)	neutrons		1
3(b)	heavier than H-2 atoms are heavier than H-1 atoms **or** the hydrogen atoms are heavier / more particles in the nucleus of the hydrogen atoms / one more particle in each hydrogen atom / a neutron in each hydrogen atom etc **or** molecule A has more particles / neutrons **or** molecule A has a larger nuclear mass / atomic mass A has two more neutrons than B	 can be awarded even if they do not circle heavier than must be linked to heavier than a correct explanation of the increase in mass by ref. to the particles in the hydrogen atoms ignore reference to particles in the oxygen atoms do **not** accept incorrect numbers of particles accept molecule A has more protons and neutrons molecule A has higher mass numbers hydrogen has a greater mass number in A all the numbers in the molecule A add up to 6 and in molecule B add up to 4 molecule A has $^{2}_{1}H$ and B $^{1}_{1}H$	1 1 1
Total			**4**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	the diameter of the tube is very small		1
4(b)(i)	three		1
4(b)(ii)	covalent		1
4(b)(iii)	bonds		1
Total			**4**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	48		1
5(a)(ii)	3		1
5(b)	heat / energy given out / transfers to surroundings	 the mark for given out / transfers to cannot be awarded without heat / energy allow given off	1 1
5(c)	it has a low boiling point it is made of small molecules		1 1
Total			**6**

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CHY2F

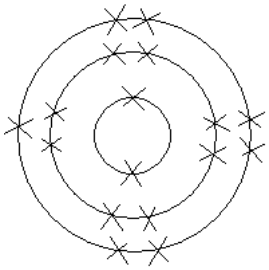
Question 6

question	answers	extra information	mark
6(a)(i)	mix (owtte)	accept to allow more collisions / helps particles to collide (owtte) idea of more efficient heat transfer do **not** allow heat is a catalyst	1
6(a)(ii)	higher **and** more powder **and** big concentrated **and** more		1 1 1
6(b)	electrons		1
6(c)	H^+		1
Total			**6**

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CHY2F

Question 7

question	answers	extra information	mark
7(a)		accept dots / crosses / e must be drawn on diagram electrons do not need to be paired ignore brackets or + or −charges ignore 2,8,7	1
7(b)	(one) electron lost / given away / transferred from sodium / transferred to chlorine owtte	recognition that electrons are involved must be linked to electrons accept loses electron(s) for **2** marks NB loses 2 or more electrons gains **1** mark reference to sharing / covalent max **1** mark ignore charges on ions formed	1 1
7(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are attracted or it is oppositely charged ignore opposite forces attract	1
7(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 7 continues on next page

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CHY2F

Question 7 continued

question	answers	extra information	mark
7(d)(i)	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging do **not** accept answers such as global warming / ozone layer etc. ignore safety unless qualified	1
7(d)(ii)	any **one** sensible idea eg • loss of work / unemployment **or** company goes out of business • any adverse effect on local economy (owtte) • any adverse effect on paper production / cost of paper / cost of water (treatment) • chlorine (compounds) have been used (for many years) without causing harm owtte • only a tiny amount of chlorine is released so it would not cause harm	eg shops / house prices etc. allow less expensive to use chlorine or converse ignore uses of chlorine to treat drinking water unless qualified	1
7(d)(iii)	ideas related to bias	accept more reliable or valid or fair ignore more accurate / fair test	1
Total			**8**

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Question 8

question	answers	extra information	mark
8(a)	gas / g	accept low density / low boiling point **or** weak intermolecular forces **or** small molecules **or** simple molecules **or** simple molecular (structure) accept volatile **or** easy to evaporate ignore very light ignore incorrect name of gas	1
8(b)	filter / filtration	accept filter paper accept decant / centrifuge ignore filter funnel / sieving / drained off / funnelling ignore names of compounds ignore evaporation / heating if after filtration do **not** accept crystallisation	1
8(c)	evaporation / crystallisation	accept heating / boiling accept 'leave for a few days' owtte allow cool do **not** allow freeze ignore filtration	1

Question 8 continues on next page

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CHY2F

Question 8 continued

question	answers	extra information	mark
8(d)	candidates can gain marks from any two of the three linked pairs		
	hydrogen chloride escaped / released (into atmosphere) **or** (hydrogen chloride) damaged vegetation / harmful	to get both of these **2** marks hydrogen chloride must be mentioned ignore HCl formed / produced / made	1
	used to make chlorine / bleach	ignore sale of hydrogen chloride	1
	unpleasant smell (of calcium sulfide) **or** waste of calcium (sulfide)	ignore calcium sulphide alone allow calcium / calcium sulfate for calcium sulphide to get both of these 2 marks calcium (sulphide) must be mentioned	1
	converted to sulfur **or** used to make sulfuric acid	ignore sale of calcium sulfide	1
	unreacted coal (1) recycled / burnt / used / sold (1)	must be linked to first coal point	
Total			**7**

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature								

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General Certificate of Secondary Education
June 2009

ADDITIONAL SCIENCE
Unit Chemistry C2

CHY2F

F

CHEMISTRY
Unit Chemistry C2

Foundation Tier

Thursday 4 June 2009 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed: 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

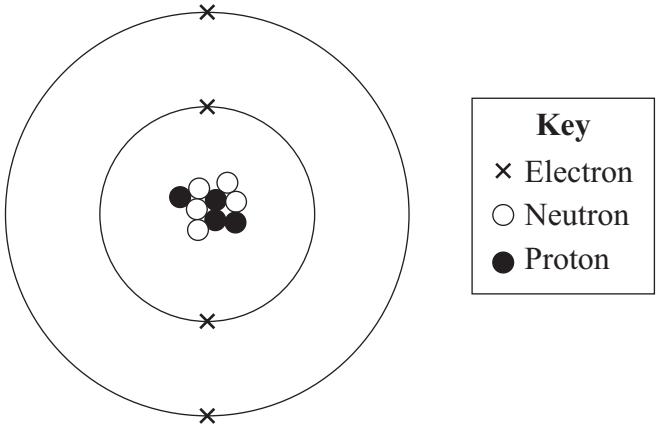
For Examiner's Use			
Question	Mark	Question	Mark
1		7	
2		8	
3			
4			
5			
6			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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Answer **all** questions in the spaces provided.

1 The diagram represents an atom of beryllium.



Use a number from the box to complete each sentence.

4	**7**	**9**	**12**

1 (a) The atomic number (proton number) of this atom is ☐ .

(1 mark)

1 (b) The mass number of this atom is ☐ .

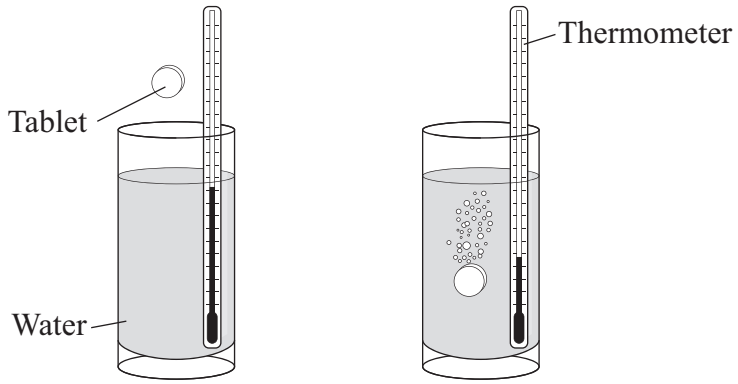
(1 mark)

2

Areas outside the box will not be scanned for marking

2 An indigestion tablet contains sodium hydrogencarbonate and citric acid.

When the tablet is added to cold water a chemical reaction takes place and there is a lot of fizzing.



2 (a) The formula of the gas that causes the fizzing is CO_2

Name this gas ..... . *(1 mark)*

2 (b) This chemical reaction is endothermic.

2 (b) (i) Tick (✓) the statement which describes what happens to the temperature of the solution.

Statement	**Tick (✓)**
The temperature of the solution will increase.	
The temperature of the solution will decrease.	
The temperature of the solution will stay the same.	

(1 mark)

2 (b) (ii) Tick (✓) the statement which describes what happens to the energy during the reaction.

Statement	**Tick (✓)**
Energy is given out to the surroundings.	
Energy is taken in from the surroundings.	
No energy is given out to or taken from the surroundings.	

(1 mark)

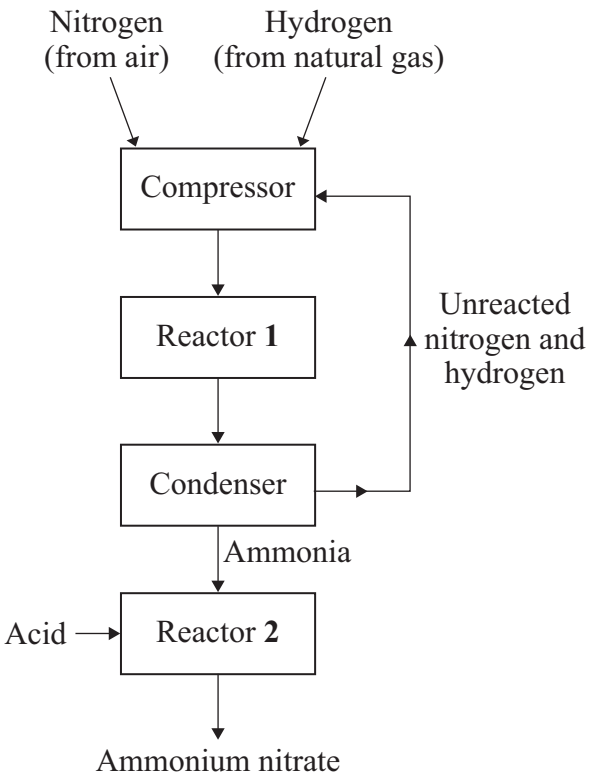
3

Turn over ▶

Areas outside the box will not be scanned for marking

3 Ammonium nitrate is an important chemical. The diagram shows the main stages in the manufacture of ammonium nitrate.

Study the diagram and then answer the questions.



Draw a ring around the correct answer in each box to complete the sentences.

3 (a) The compressor increases the [pressure / temperature / volume] to 200 atmospheres.

(1 mark)

3 (b) In reactor **1** ammonia is made by reacting [air / natural gas / nitrogen] with [air. / hydrogen. / natural gas.]

(2 marks)

Areas outside the box will not be scanned for marking

3 (c) In the condenser the mixture is [cooled / heated / reduced] and the ammonia is separated as a liquid. *(1 mark)*

3 (d) In reactor **2** ammonium nitrate is made by reacting ammonia with [hydrochloric / sulfuric / nitric] acid. *(1 mark)*

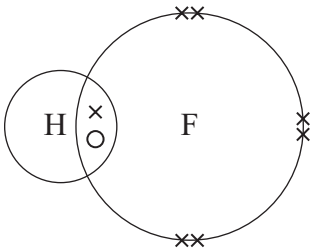
5

Turn over for the next question

Areas outside the box will not be scanned for marking

4 This question is about fluorine and some of its compounds.

4 (a) The diagram represents a molecule of hydrogen fluoride.



Draw a ring around the type of bonding that holds the hydrogen and fluorine atoms together in this molecule.

covalent **ionic** **metallic**

(1 mark)

4 (b) Fluorine is made in industry by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.

4 (b) (i) Use **one** word from the box to complete the sentence.

gas	**liquid**	**solid**

To allow electrolysis to take place the mixture of potassium fluoride and

hydrogen fluoride must be ..... . *(1 mark)*

Areas outside the box will not be scanned for marking

4 (b) (ii) The mixture of potassium fluoride and hydrogen fluoride contains fluoride ions (F^-), hydrogen ions (H^+) and potassium ions (K^+).

Use **one** word from the box to complete the sentence.

fluorine	**hydrogen**	**potassium**

During electrolysis the element formed at the **positive** electrode is

..... . *(1 mark)*

4 (c) Fluoride ions are sometimes added to drinking water. It is thought that these ions help to reduce tooth decay.

4 (c) (i) Tick (✓) **one** question that **cannot** be answered by scientific investigation alone.

Question	**Tick (✓)**
Do fluoride ions in drinking water reduce tooth decay?	
Are fluoride ions in drinking water harmful to health?	
Should fluoride ions be added to drinking water?	

(1 mark)

4 (c) (ii) Explain why you have chosen this question.

.....

.....

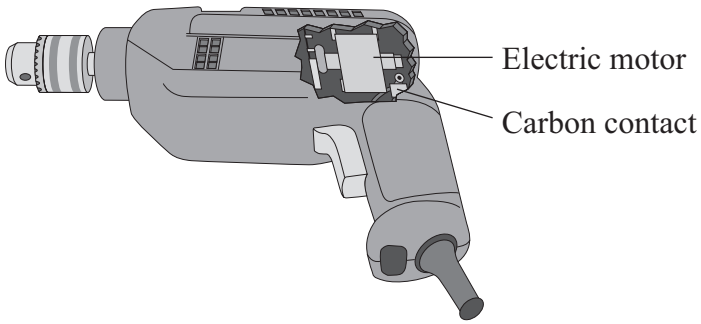
(1 mark)

5

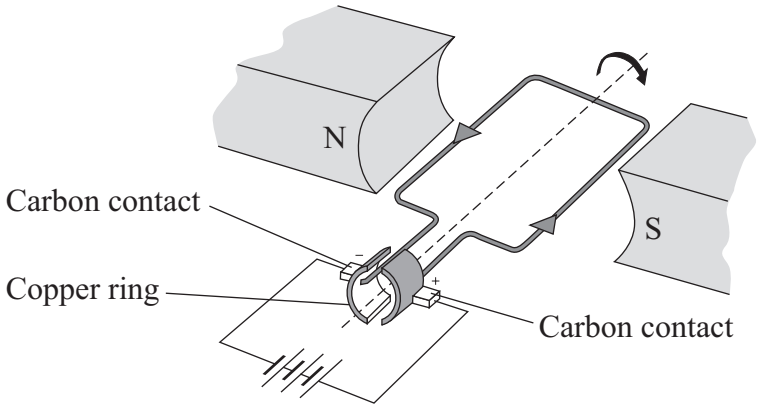
Turn over for the next question

Areas outside the box will not be scanned for marking

5 This drill contains an electric motor.



The diagram below shows the main parts of an electric motor.



The carbon contacts are made of graphite. Springs push the contacts against the copper ring. The carbon contacts conduct electricity to the copper ring. The copper ring rotates rapidly but does not stick or become worn because the graphite is soft and slippery.

5 (a) Using this information give **two** properties that make graphite suitable for making the carbon contacts.

1.....

.....

2.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

5 (b) (i) Draw a ring around the correct word in each box to complete the sentence.

Each carbon atom in graphite is joined to

two
three
four

other carbon atoms by

covalent
ionic
metallic

bonds.

(2 marks)

5 (b) (ii) Tick (✓) the statement which explains why graphite is soft and slippery.

Statement	**Tick (✓)**
It is made of layers of atoms.	
It is made of small molecules.	
It is an ionic compound.	

(1 mark)

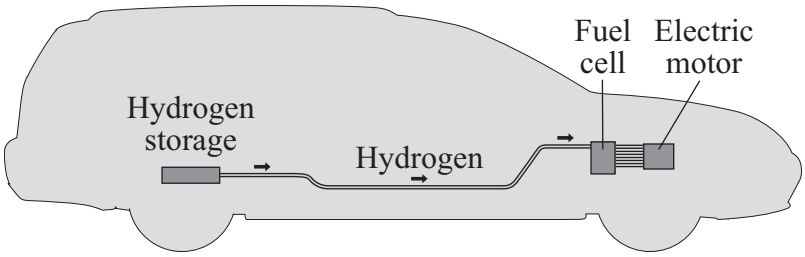
5

Turn over for the next question

Areas outside the box will not be scanned for marking

6 Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. On combustion it reacts with oxygen from the air to release a large amount of energy. The only product of combustion is water which does not cause pollution. Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. Hydrogen stored in lithium nitride will not explode.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

Areas outside the box will not be scanned for marking

6 (a) Use information from the article to help you to answer these questions.

6 (a) (i) Give **two** reasons why hydrogen is an excellent fuel.

1 .....

.....

2 .....

.....

(2 marks)

6 (a) (ii) Hydrogen stored in lithium nitride is safer in an accident than a cylinder full of hydrogen gas.

State why.

.....

.....

(1 mark)

6 (a) (iii) What is the advantage of using 'nanosized' particles of lithium nitride instead of normal sized particles for storing hydrogen?

.....

.....

(1 mark)

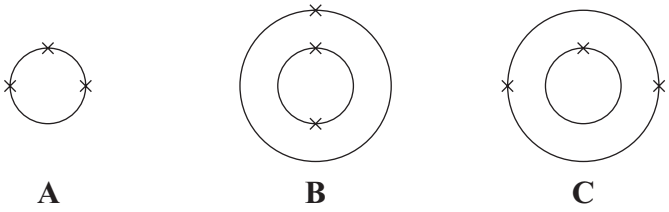
Question 6 continues on the next page

Areas outside the box will not be scanned for marking

6 (b) Lithium nitride is an ionic compound that contains lithium ions (Li^+) and nitride ions (N^{3-}).

6 (b) (i) The periodic table on the Data Sheet may help you to answer this question.

Which diagram, **A**, **B** or **C**, represents the electronic structure of a lithium atom?
Write your answer in the box.



A **B** **C**

Diagram ☐

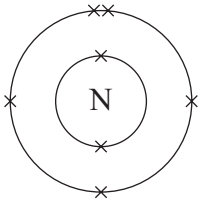
(1 mark)

6 (b) (ii) Tick (✓) the statement which describes how a lithium atom (Li) changes into a lithium ion (Li^+).

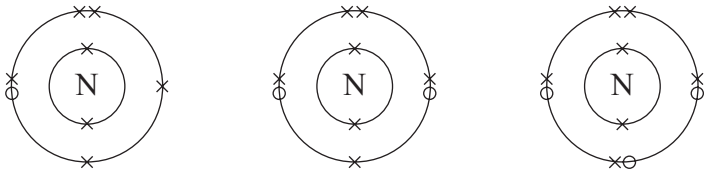
Statement	**Tick (✓)**
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(1 mark)

6 (b) (iii) The diagram shows the electronic structure of a nitrogen atom.



Which diagram, **A**, **B** or **C**, represents the electronic structure of a nitride ion (N^{3-})?
Write your answer in the box.



A **B** **C**

Diagram ☐

(1 mark)

Areas outside the box will not be scanned for marking

6 (c) The equation for the reaction of lithium nitride with hydrogen is:

$$Li_3N + 2H_2 \rightleftharpoons LiNH_2 + 2LiH$$

What does the $\rightleftharpoons$ symbol mean?

Draw a ring around your answer.

reversible reaction **endothermic reaction** **neutralisation**

(1 mark)

6 (d) Draw a ring around the correct answer in each box to complete the sentences.

6 (d) (i) 'Nanosized' particles of lithium nitride will be

much larger
a little larger
much smaller

than normal sized particles of lithium nitride. *(1 mark)*

6 (d) (ii) One of the reasons why 'nanosized' particles have different properties from normal sized particles is that they have a greater

density
mass
surface area

than normal sized particles of lithium nitride. *(1 mark)*

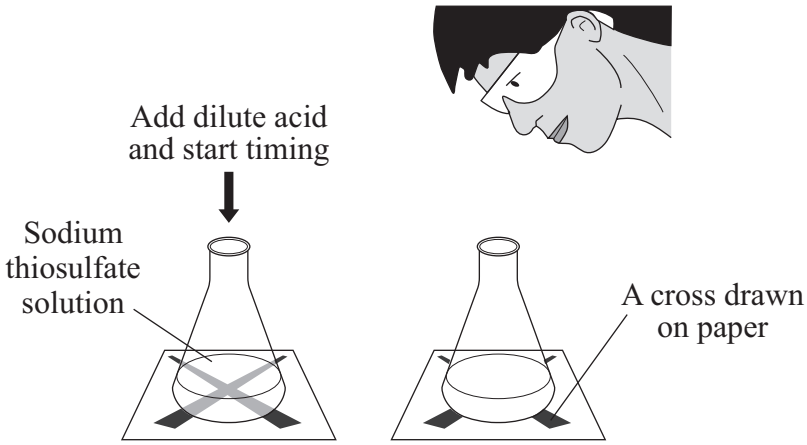
10

Turn over for the next question

Areas outside the box will not be scanned for marking

7 Sodium thiosulfate solution reacts with hydrochloric acid. As the reaction takes place the solution slowly turns cloudy.

The diagram shows a method of measuring the rate of this reaction.



A student used this method to investigate how changing the concentration of the sodium thiosulfate solution affects the rate of this reaction.

The student used different concentrations of sodium thiosulfate solution. All the other variables were kept the same.

The results are shown on the graph on the opposite page.

7 (a) (i) Draw a line of best fit on the graph. *(1 mark)*

7 (a) (ii) Suggest **two** reasons why all of the points do not lie on the line of best fit.

1 .....

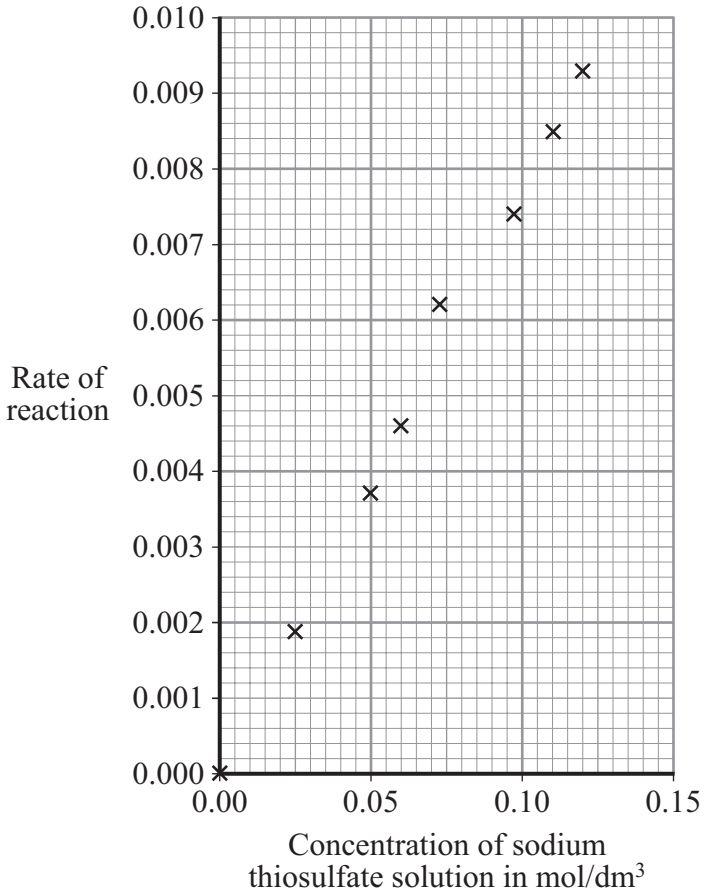
.....

2 .....

.....

(2 marks)

Areas outside the box will not be scanned for marking



7 (b) (i) In a conclusion to the investigation the student stated that:

'The rate of this reaction is directly proportional to the concentration of the sodium thiosulfate solution.'

How does the graph support this conclusion?

.....

.....

(1 mark)

7 (b) (ii) Explain, in terms of particles, why the rate of reaction increases when the concentration of sodium thiosulfate is increased.

.....

.....

.....

.....

(2 marks)

6

Turn over ▶

Areas outside the box will not be scanned for marking

8 This question is about methods of treating water.

8 (a) Chlorine is used to kill microorganisms in water. When chlorine is added to water a chemical reaction takes place. The equation for this reaction is shown below.

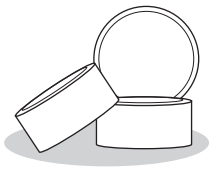
$$Cl_2(g) + H_2O(l) \rightleftharpoons 2H^+(aq) + OCl^-(aq) + Cl^-(aq)$$

An acidic solution is produced when chlorine reacts with water.

Which ion, shown in the equation, makes the solution acidic? .....

(1 mark)

8 (b) Calcium hypochlorite tablets are added to water in some swimming pools to kill microorganisms.



The formula of calcium hypochlorite is $CaCl_2O_2$

8 (b) (i) Calculate the relative formula mass (M_r) of calcium hypochlorite.

Relative atomic masses: O = 16; Cl = 35.5; Ca = 40.

.....

.....

Relative formula mass (M_r) of calcium hypochlorite = ...

(2 marks)

8 (b) (ii) Calculate the percentage by mass of chlorine in calcium hypochlorite.

.....

.....

Percentage by mass of chlorine in calcium hypochlorite = ... %

(2 marks)

Areas outside the box will not be scanned for marking

8 (b) (iii) Calculate the mass of chlorine in a 20 g tablet of calcium hypochlorite.

.....

.....

Mass of chlorine = ... g

(1 mark)

8 (c) Waste water from some industrial processes sometimes contains harmful metal ions, such as chromium ions. These ions must be removed from the water before it can be returned to a river.
A method of removing chromium ions (Cr^{3+}) from water is represented by this equation.

$$Cr^{3+}(aq) + 3OH^{-}(aq) \rightarrow Cr(OH)_3(s)$$

8 (c) (i) What type of substance would be added to the water to provide the OH^- ions?

.....

.....

(1 mark)

8 (c) (ii) A *precipitate* is formed in this reaction.

What is a *precipitate*?

.....

.....

(1 mark)

8 (c) (iii) What method could be used to separate the precipitate from the solution?

.....

.....

(1 mark)

9

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

Data Sheet

1. Reactivity Series of Metals

Potassium	most reactive
Sodium	↑
Calcium	
Magnesium	
Aluminium	
Carbon	
Zinc	
Iron	
Tin	
Lead	
Hydrogen	
Copper	
Silver	
Gold	↓
Platinum	least reactive

(elements in italics, though non-metals, have been included for comparison)

2. Formulae of Some Common Ions

Positive ions		Negative ions	
Name	Formula	Name	Formula
Hydrogen	H^+	Chloride	Cl^-
Sodium	Na^+	Bromide	Br^-
Silver	Ag^+	Fluoride	F^-
Potassium	K^+	Iodide	I^-
Lithium	Li^+	Hydroxide	OH^-
Ammonium	NH_4^+	Nitrate	NO_3^-
Barium	Ba^{2+}	Oxide	O^{2-}
Calcium	Ca^{2+}	Sulfide	S^{2-}
Copper(II)	Cu^{2+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}	Carbonate	CO_3^{2-}
Zinc	Zn^{2+}		
Lead	Pb^{2+}		
Iron(II)	Fe^{2+}		
Iron(III)	Fe^{3+}		
Aluminium	Al^{3+}		

Turn over ▶

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3. The Periodic Table of 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 Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Cu and **Cl** have not been rounded to the nearest whole number.

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit 2 Chemistry

Mark Scheme

2009 examination – June series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell Director General

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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CHY2F

Question 1

question	answers	extra information	mark
1(a)	4		1
1(b)	9		1
Total			**2**

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Question 2

question	answers	extra information	mark
2(a)	carbon dioxide	must be name do **not** accept carbon oxide	1
2(b)(i)	the temperature of the solution will decrease	(list principle)	1
2(b)(ii)	energy is taken in from the surroundings	(list principle)	1
Total			**3**

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CHY2F

Question 3

question	answers	extra information	mark
3(a)	pressure		1
3(b)	nitrogen hydrogen		1 1
3(c)	cooled		1
3(d)	nitric		1
Total			**5**

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CHY2F

Question 4

question	answers	extra information	mark
4(a)	covalent		1
4(b)(i)	liquid		1
4(b)(ii)	fluorine	accept F / F_2 do **not** accept fluoride	1
4(c)(i)	should fluoride ions be added to drinking water?		1
4(c)(ii)	any **one** from: • not enough reliable/valid evidence • may be other factors involved • it is an opinion / choice / belief / ethics issue • it can't be scientifically investigated	mark independently of (c)(i) allow can't do an experiment ignore test	1
Total			**5**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)	any **two** from: • conducts electricity • soft • slippery • high melting point	ignore hardwearing / does not stick apply list principle	2
5(b)(i)	three covalent		1 1
5(b)(ii)	it is made of layers of atoms		1
Total			**5**

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CHY2F

Question 6

question	answers	extra information	mark
6(a)(i)	gives out a large amount of energy only water produced / product is non polluting (owtte)	 allow it does not harm the environment	1 1
6(a)(ii)	does not explode / burst into flames owtte	ignore will not react	1
6(a)(iii)	hydrogen absorbed and released much faster	allow more efficient allow can store a larger amount	1
6(b)(i)	B		1
6(b)(ii)	a lithium atom loses an electron		1
6(b)(iii)	C		1
6(c)	reversible		1
6(d)(i)	much smaller		1
6(d)(ii)	surface area		1
Total			**10**

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Question 7

question	answers	extra information	mark
7(a)(i)	a continuous straight line missing anomalous point	allow a line which does not start at zero / origin	1
7(a)(ii)	any **two** sensible errors eg • timing errors and / or example • measurement errors and / or example • apparatus errors and / or example • human / experimental / random error and / or example or 'did not do it right' • temperature fluctuation • anomalous point • results not recorded correctly • plotting error • rate calculated incorrectly	ignore systematic / zero error / weighing error **or** error unqualified could be two from **same** category eg two timing errors – watch not started at the same time plus difficulty in deciding when the cross has disappeared. accept outlier / wrong result ignore 'not repeated'	2
7(b)(i)	straight line **or** as concentration increases the rate goes up **or** converse	accept numerical example accept positive correlation accept same gradient ignore 'most points near / on line of best fit'	1

Question 7 continues on the next page…

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CHY2F

Question 7 Continued

question	answers	extra information	mark
7(b)(ii)	more collisions	accept greater chance of collisions accept collide more successfully accept alternative versions of collide eg 'bump / hit' ignore references to energy / speed of particles / surface area	1
	more particles (in each volume of solution)(i.e. an attempt at defining concentration)	accept 'particles are closer together' allow ions / atoms / molecules for particles ignore reactants accept greater frequency of collisions **or** greater number of collisions per second for **2** marks	1
Total			**6**

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CHY2F

Question 8

question	answers	extra information	mark
8(a)	hydrogen / H^+ /$2H^+$ / H_3O^+	allow H / 2H do **not** accept H_2 apply list principle	1
8(b)(i)	143	correct answer with or without working = **2** marks ignore units if answer is not correct 40 + (2 × 35.5) + (2 × 16) gains **1** mark	2
8(b)(ii)	49.7% (49.6 to 50)	correct answer with or without working = **2** marks answer 49 gains **1** mark if answer is not correct: (71 ÷ 143) × 100 gains **1** mark allow error carried forward from part (b)(i) ie. (71 or their (2 × 35.5) ÷ answer to (b)(i)) × 100 gains **2** marks if calculated correctly and **1** mark if not calculated correctly. **Special case** 35.5 ÷ 143 × 100 = 24.8 to 25% **or** 35.5 ÷ answer to (b)(i) x 100 correctly calculated for **1** mark	2
8(b)(iii)	9.9 to 10g	allow ecf from (b)(i) or (b)(ii)	1

Question 8 continued on next page…

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CHY2F

Question 8

question	answers	extra information	mark
8(c)(i)	an alkali	apply list principle accept named alkali accept hydroxide accept soluble base ignore base	1
8(c)(ii)	a solid / insoluble substance (owtte)		1
8(c)(iii)	filter / filtration	allow decant / centrifuge accept filtration followed by evaporation **or** filtration and evaporation do **not** accept filtration or evaporation do **not** accept evaporation and filtration	1
Total			**9**

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
January 2009

ADDITIONAL SCIENCE
Unit Chemistry C2

CHY2F

F

CHEMISTRY
Unit Chemistry C2

Foundation Tier

Thursday 15 January 2009 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed: 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

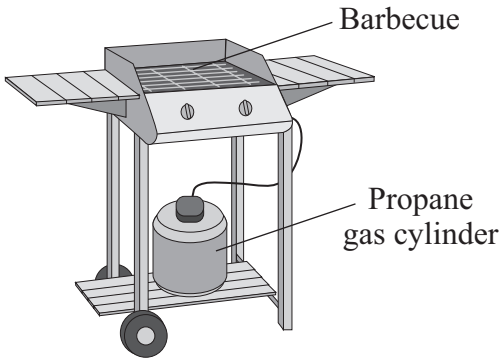
For Examiner's Use			
Question	Mark	Question	Mark
1		7	
2		8	
3		9	
4			
5			
6			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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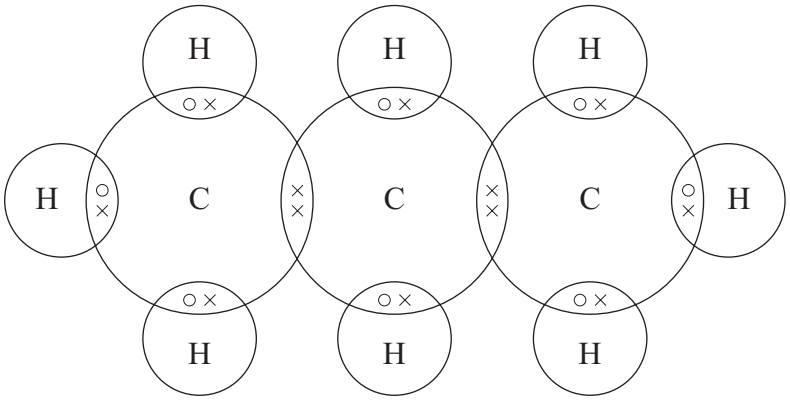
Areas outside the box will not be scanned for marking

Answer **all** questions in the spaces provided.

1 This barbecue burns propane gas.



The diagram represents a propane molecule.



1 (a) What is the formula of propane? .....

(1 mark)

1 (b) (i) Draw a ring around the name of the particle represented by the symbols ○ and × in the diagram.

electron **neutron** **proton**

(1 mark)

Areas outside the box will not be scanned for marking

1 (b) (ii) Draw a ring around the type of bonding that holds the atoms together in a propane molecule.

covalent **ionic** **metallic**

(1 mark)

1 (c) Under high pressure in the cylinder propane is a liquid.
Liquid propane evaporates easily to form a gas when the tap on the cylinder is opened.

Draw a ring around the correct answer in each box to explain why propane evaporates easily.

Propane has a [high / low] boiling point because it consists of [large / small] molecules.

(1 mark)

4

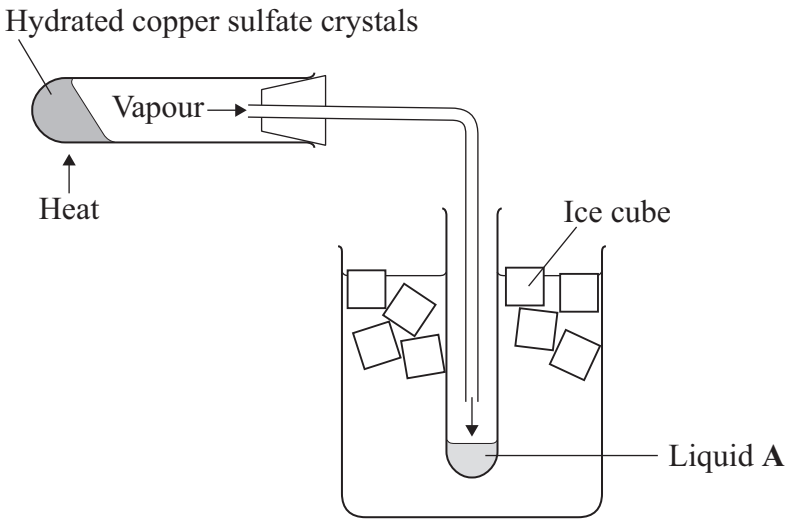
Turn over for the next question

Areas outside the box will not be scanned for marking

2 A student heated some hydrated copper sulfate crystals.
The equation for this reaction is shown below.

$$\underset{\text{hydrated copper sulfate crystals}}{CuSO_4.5H_2O\ (s)} \rightleftharpoons \underset{\text{anhydrous copper sulfate}}{CuSO_4\ (s)} + \underset{\text{water}}{5H_2O\ (l)}$$

The diagram shows the apparatus used.



2 (a) Name liquid **A** .....

(1 mark)

2 (b) What helped the vapour to condense into liquid **A**?

.....

.....

(1 mark)

2 (c) Put a tick (✓) next to the correct meaning of the symbol $\rightleftharpoons$

Meaning	(✓)
equal amounts of reactants and products	
exothermic reaction	
reversible reaction	

(1 mark)

Areas outside the box will not be scanned for marking

2 (d) The student weighed the copper sulfate before and after it was heated.
The experiment was repeated and the two sets of results are shown in the table.

Mass of copper sulfate before heating in grams	Mass of copper sulfate after heating in grams	Mass lost in grams
2.50	1.65	0.85
2.50	1.61	0.89

2 (d) (i) Draw a ring around the **average** mass lost for these two sets of results.

0.85 g **0.87 g** **0.89 g**

(1 mark)

2 (d) (ii) The student used the same mass of copper sulfate each time but the mass lost was different.

Put a tick (✓) next to the **two** reasons which could explain why the mass lost is different.

Reason	(✓)
The student used different test tubes for the two experiments.	
The student made errors in weighing during the experiments.	
The student used more ice in one of the experiments.	
The student did not heat the copper sulfate for long enough in one of the experiments.	

(2 marks)

2 (e) Anhydrous copper sulfate is used to test for water.

Use words from the box to complete the sentence.

blue	**green**	**red**	**white**

Water changes the colour of anhydrous copper sulfate from .....

to ..... .

(2 marks)

8

Areas outside the box will not be scanned for marking

3 This label was on a container of graphite lubricant.

> ***Super G***
>
> **Graphite Lubricant**
>
> ***Super G*** forms a thin anti-friction film on metal surfaces. It provides good lubrication when metal parts rub against each other.

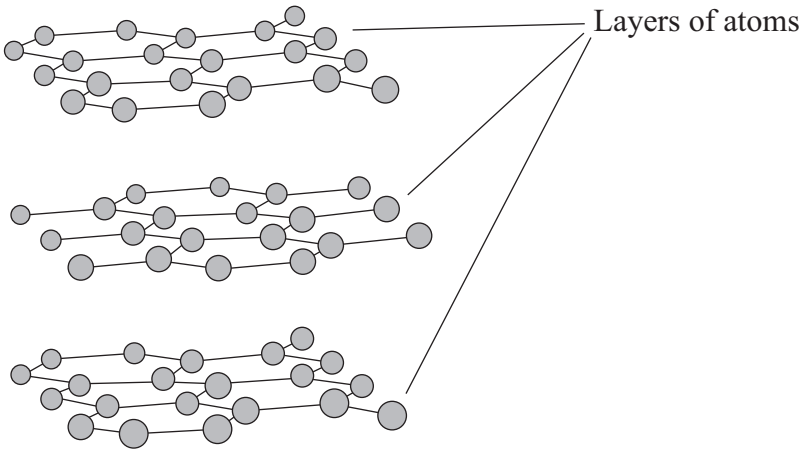
3 (a) Give **one** reason why a lubricant is used when metal parts rub against each other.

.....

.....

(1 mark)

3 (b) The diagram shows the arrangement of atoms in graphite.



3 (b) (i) Draw a ring around the type of atoms in graphite.

aluminium **carbon** **silicon**

(1 mark)

Areas outside the box will not be scanned for marking

3 (b) (ii) Graphite is a good lubricant because it is slippery. Use the diagram to explain why graphite is slippery.

.....

.....

.....

.....

.....

(2 marks)

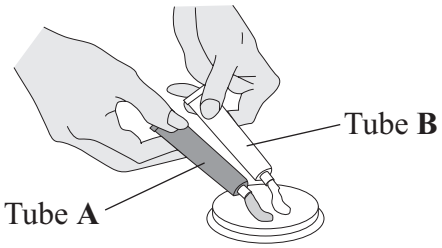
4

Turn over for the next question

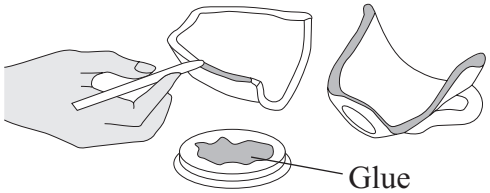
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4 The following steps show how to use a type of glue.

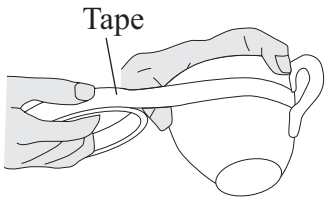
Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.



Step 2 Mix the liquids to make the glue.
Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Assemble the pieces to be joined and then hold them together with tape.



Step 4 Leave the glue to set.

4 (a) When liquids **A** and **B** are mixed a chemical reaction takes place.

4 (a) (i) This reaction is exothermic.

Complete the sentence below using a word or phrase from the box.

decrease	**increase**	**stay the same**

During the reaction the temperature of the mixture will ..... .

(1 mark)

Areas outside the box will not be scanned for marking

4 (a) (ii) When the glue sets it forms a giant covalent structure.

Draw a ring around **one** property that you would expect the set glue to have.

good conductor of electricity **low melting point** **high melting point**

(1 mark)

4 (b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in °C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

4 (b) (i) Complete the sentences below using words or phrases from the box.

decreases	**increases**	**stays the same**

When the temperature is increased the time taken for the glue to set

..... .

When the temperature is increased the rate of the setting reaction

..... .

(2 marks)

4 (b) (ii) Put a tick (✓) next to the **two** reasons why an increase in temperature affects the rate of reaction.

Reason	(✓)
It gives the particles more energy.	
It increases the concentration of the particles.	
It increases the surface area of the particles.	
It makes the particles move faster.	

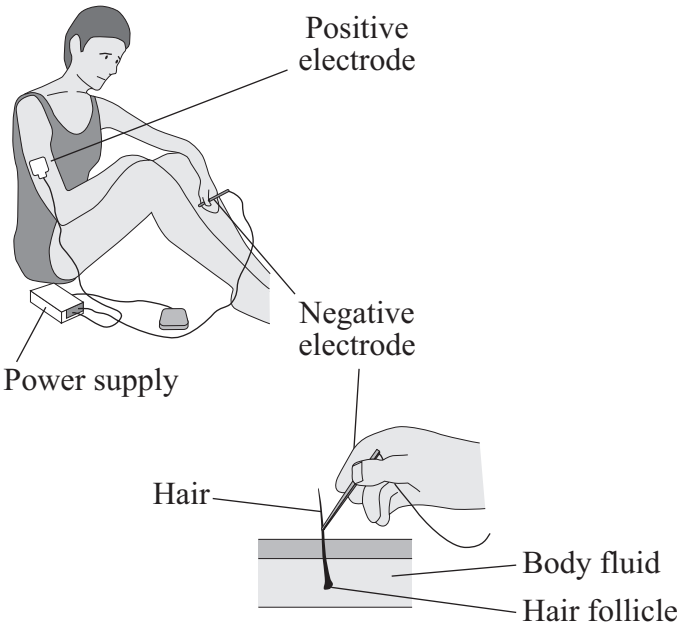
(2 marks)

6

Turn over ▶

Areas outside the box will not be scanned for marking

5 Electrolysis can be used to remove unwanted hair from the skin.



The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair.

The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

5 (a) In this solution hydrogen ions move to the negative electrode.

Complete the sentence using **one** word from the box.

negative	**neutral**	**positive**

Hydrogen ions move to the negative electrode because they have a

..... charge.

(1 mark)

5 (b) Draw a ring around the name of the gas produced at the positive electrode during the electrolysis of sodium chloride solution.

chlorine **hydrogen** **nitrogen**

(1 mark)

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Areas outside the box will not be scanned for marking

5 (c) The electrolysis of the sodium chloride solution forms a strong alkali around the hair follicle.

5 (c) (i) Complete the name of this strong alkali using **one** of the words from the box.

chloride	**hydroxide**	**nitrate**

The name of this strong alkali is sodium ..... .

(1 mark)

5 (c) (ii) Suggest how this strong alkali helps to remove the hair.

.....

.....

(1 mark)

4

Turn over for the next question

Areas outside the box will not be scanned for marking

6 Read the article and then answer the questions that follow.

Nanotennis!

Tennis balls contain air under pressure, which gives them their bounce. Normal tennis balls are changed at regular intervals during tennis matches because they slowly lose some of the air. This means that a large number of balls are needed for a tennis tournament, using up a lot of materials.



'Nanocoated' tennis balls have a 'nanosize' layer of butyl rubber. This layer slows down the escape of air so that the ball does not lose its pressure as quickly. The 'nanocoated' tennis balls last much longer and do not need to be replaced as often.

6 (a) How does the 'nanosize' layer make the tennis balls last longer?

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

6 (b) Put a tick (✓) next to the best description of a 'nanosize' layer.

Description	(✓)
A layer one atom thick.	
A layer a few hundred atoms thick.	
A layer millions of atoms thick.	

(1 mark)

6 (c) Suggest why using 'nanocoated' tennis balls would be good for the environment.

.....

.....

.....

.....

.....

(2 marks)

4

Turn over for the next question

Areas outside the box will not be scanned for marking

7 Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.



7 (a) The formula of iron(II) sulfate is $FeSO_4$

Calculate the relative formula mass (M_r) of $FeSO_4$

Relative atomic masses: O = 16; S = 32; Fe = 56.

.....

.....

The relative formula mass (M_r) = ... *(2 marks)*

7 (b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

.....

(1 mark)

7 (c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron? Remember to give the unit.

.....

(1 mark)

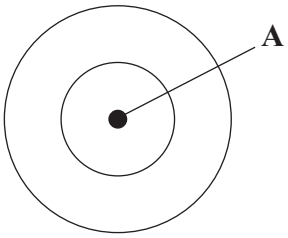
4

Areas outside the box will not be scanned for marking

8 This question is about oxygen atoms. The periodic table on the Data Sheet may help you to answer this question.

8 (a) (i) Oxygen atoms have 8 electrons.

Complete the diagram to represent the arrangement of electrons in an oxygen atom.
Use crosses (×) to represent the electrons.



(1 mark)

8 (a) (ii) Name the part of the oxygen atom that is labelled **A** on the diagram.

.....

(1 mark)

8 (b) Two isotopes of oxygen are oxygen-16 and oxygen-18.

$^{16}_{8}O$ **oxygen-16**

$^{18}_{8}O$ **oxygen-18**

Explain, in terms of particles, how the nucleus of an oxygen-18 atom is different from the nucleus of an oxygen-16 atom.

.....

.....

.....

.....

(2 marks)

4

Turn over ▶

Areas outside the box will not be scanned for marking

9 Read the information below and then answer the questions that follow.

It was once thought that organic compounds could be made only in living organisms. The living organisms were assumed to have a special life force. This life force allowed them to make organic compounds.

Urea is an organic compound produced in animals. It is found in urine. In 1828, Friedrich Wöhler made urea from chemicals which were not obtained from living things.



Other famous scientists still believed in the idea of a life force. Wöhler made another organic compound in 1845. Most scientists then stopped believing that a life force was needed to make organic compounds.

9 (a) How did Wöhler prove that a life force is **not** needed to make organic compounds?

.....

.....

(1 mark)

9 (b) Suggest why in 1828 most scientists continued to believe that a life force was needed to produce an organic compound.

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

9 (c) Suggest why in 1845 most scientists stopped believing that a life force was needed to make an organic compound.

.....

.....

(1 mark)

9 (d) Some scientists repeated Wöhler's experiment.

These scientists used lead nitrate as one of their starting materials.

Lead nitrate solution can be made by reacting lead with an acid.

9 (d) (i) Give the name of this acid. .....

(1 mark)

9 (d) (ii) State how solid lead nitrate can be obtained from lead nitrate solution.

.....

.....

(1 mark)

9 (e) The equations below show two methods of making urea.

Method 1 (Wöhler's method)

$$Pb(NO_3)_2 + 2KCNO + 2NH_3 + 2H_2O \rightarrow 2KNO_3 + Pb(OH)_2 + 2(NH_2)_2CO$$

urea

Method 2 (The modern industrial method)

$$2NH_3 + CO_2 \rightarrow (NH_2)_2CO + H_2O$$

urea

Method **2** has a higher atom economy than method **1**.

Use information from the equations to explain why.

.....

.....

.....

.....

(2 marks)

7

END OF QUESTIONS

There are no questions printed on this page

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2F Unit Chemistry 2

Mark Scheme

2009 examination – January series

STEMUP.CO.UK

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell Director General

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
1(a)	C_3H_8	capital letters for symbols numbers must be halfway or lower down the element symbol allow H_8C_3 do **not** allow 3:8 **or** C_3 and H_8	1
1(b)(i)	electron		1
1(b)(ii)	covalent		1
1(c)	low **and** small	both for **1** mark	1
Total			**4**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
2(a)	water	accept H_2O **or** $5H_2O$ 2 must be below halfway	1
2(b)	the cold water / ice / cubes (owtte)	accept 'cooled down' **or** references to cold	1
2(c)	reversible reaction		1
2(d)(i)	0.87g		1
2(d)(ii)	the student made errors in weighing during the experiments the student did not heat the copper sulfate for long enough in one of the experiments		1 1
2(e)	white blue	 allow **1** mark for blue to white	1 1
Total			**8**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
3(a)	reduce wear of metal ie don't get damaged **or** stop / reduce <u>friction</u> **or** prevent seizing	**or** other sensible answer accept stop metal heating up accept move more smoothly ignore make it slippery / rub more smoothly accept can move freely	1
3(b)(i)	carbon		1
3(b)(ii)	layers (of atoms) can slide / slip over each other **or** weak forces of attraction / weak bonds (between layers)	 allow slip off allow no bonds accept there are weak forces of attraction for **1** mark even when there is no reference to layers accept atoms slide over each other (for **1** mark) an answer which **only** states there are weak bonds would gain **0** marks when there is no reference to layers weak covalent bonds = **0** marks	1 1
Total			**4**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
4(a)(i)	increase		1
4(a)(ii)	high melting point		1
4(b)(i)	decreases increases		1 1
4(b)(ii)	it gives the particles more energy it makes the particles move faster		1 1
Total			**6**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
5(a)	positive	accept + **or** +ve **or** plus	1
5(b)	chlorine		1
5(c)(i)	hydroxide	Any indication of hydro…	1
5(c)(ii)	destroys / damages / dissolves (owtte) the hair / follicle / root	allow burns / reacts with the hair ignore incorrect name of compound	1
Total			**4**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
6(a)	Stops / reduces air from escaping (owtte)	allow keeping shape **or** keeping it hard	1
6(b)	a layer a few hundred atoms thick		1
6(c)	any **two** from: • last longer • use fewer balls • less materials **or** save resources • less manufactured • less energy • less fuel • less pollution / greenhouse effect / global warming • less waste	any **two** ideas accept less factories ignore references to cost / recycling	2
Total			**4**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

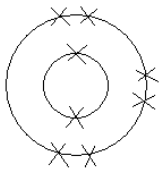
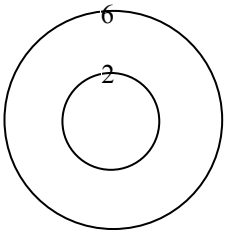
question	answers	extra information	mark
7(a)	152	correct answer with **or** without working = **2 marks** 56 + 32 + (4 ×16) gains **1** mark ignore any units	2
7(b)	152g(rams)	ecf from the answer to (a) and g must have unit g / gram / gramme / grams etc accept g / mol **or** g per mole **or** g $mole^{-1}$ **or** g/mol **or** g per mol **or** g mol^{-1} do **not** accept g m do **not** accept G	1
7(c)	76(g)	ecf from their answer to (a) or (b) divided by 2 ignore units	1
Total			**4**

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
8(a)(i)	 **or** 	allow any arrangement of electrons on the shells accept o, x, - **or** e as representing electrons	1
8(a)(ii)	nucleus	accept nucleus (protons plus neutrons) do **not** accept protons plus neutrons on its own allow nuclei / nucles / neucleus / phonetic spelling do **not** accept neutron	1

Question 8 continued on next page...

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 8 continued...

question	answers	extra information	mark
8(b)	it has **2** more neutrons **or** converse **or** O-16 has 8 neutrons (**1 mark**) O-18 has 10 neutrons (**1 mark**)	accept 'it has more neutrons' **or** 'different number of neutrons' for **1 mark** '2 more protons / electrons + correct number of neutrons' = max **1** mark if incorrectly calculated but shows more neutrons in 0-18 allow for **1** mark accept it has more particles **or** it has 2 more particles for **1** mark ignore any reference to charges just 2 more without reference to particles = **0** marks	2
Total			**4**

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question	answers	extra information	mark
9(a)	he made urea / organic compound / he made another organic compound	ignore 'he made it' unless qualified eg accept he made it from non-living material **or** not made from animals / plants	1
9(b)	any **one** from: sensible ideas eg • famous scientists / eminent scientists / high status scientists accepted the life-force theory (owtte) • sensible references to lack of status of Wöhler • was not in line with accepted ideas of time / religious beliefs etc • other sensible answers eg fake / anomalous result **or** lack of evidence / proof **or** not reliable **or** not repeated owtte	 eg it was a new idea accept only made 1 compound	1
9(c)	sensible idea such as: Wöhler made another organic compound **or** more evidence **or** repeated it	accept 'other scientists repeated his experiment / made other organic compounds'	1
9(d)(i)	nitric (acid)	Spelling must be correct accept HNO_3 correctly written ignore hydrogen nitrate	1
9(d)(ii)	evaporate **or** allow to crystallise	allow heat / boil / cool do **not** allow freeze ignore filtration ignore distillation	1

Question 9 continued on next page...

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Question 9 continued...

question	answers	extra information	mark
9(e)	any **two** from: • more of the starting materials end up as useful products • less / fewer reactants / atoms <u>used</u> **or** method 1 has more reactants / atoms <u>used</u> • method 1 has 4 reactants • method 2 has 2 reactants • less / fewer (waste) products / atoms in the products **or** method 1 has more (waste) products / atoms in products • in method one there are 2 waste products / 15 waste atoms (or similar idea) • in method two there is only one waste product / only 3 wasted atoms **or** correctly calculated atom economies for both marks method 1 : 21.3% (1) method 2 : 76.9% (1) **or** atom economy equation correctly stated (1) atom economy = $\frac{M_r \text{ of useful product}}{\text{(total) } M_r \text{ of reactants}} \times 100$ atom economy = $\frac{M_r \text{ of useful product}}{\text{(total) } M_r \text{ of products}} \times 100$ sensible explanation of why method 1 has a higher atom economy in terms of the equation (or converse) (1)	accept 'less chemicals / compounds /substances <u>used</u>' ignore less elements / materials used accept method 1 <u>uses</u> 4 chemicals accept method 2 <u>uses</u> 2 chemicals accept less waste accept unwanted chemicals for waste products accept converse accept comparison of named waste products for both marks eg in method 2 only H_2O is wasted whereas in method 1 KNO_3 and $Pb(OH)_2$ is wasted ignore purification / pollution accept 21% accept 77%	2
Total			**7**