AQA GCSE CHEMISTRY (4421)

CHEMISTRY



EXAM QUESTION PACK

UNIT C2 HIGHER TIER CHY2H PAPERS

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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	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2012

Additional Science
Unit Chemistry C2

CHY2H

H

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.

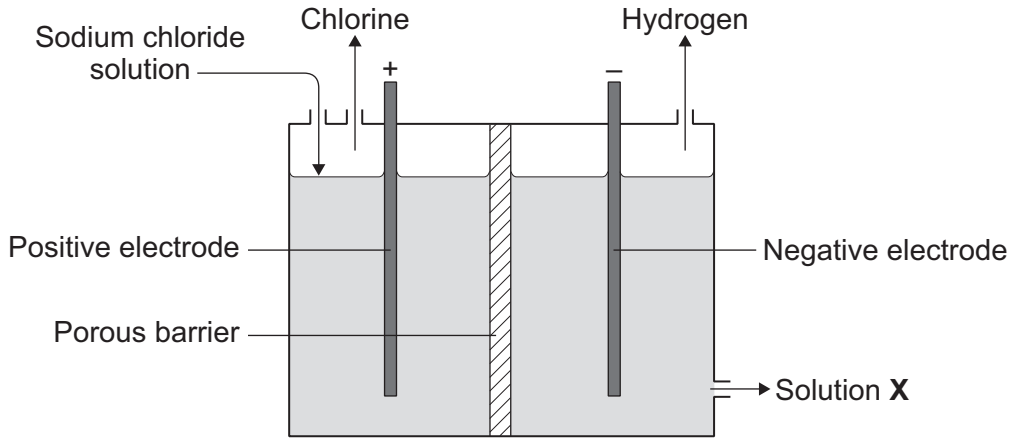
Advice
- In all calculations, show clearly how you work out your answer.

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

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



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

.....

(1 mark)

1 (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)

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

Which ion makes solution **X** alkaline?

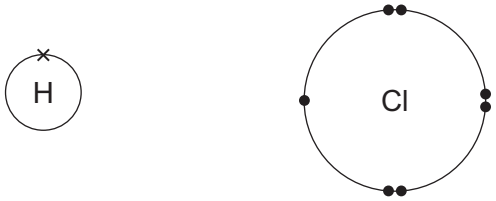
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(1 mark)

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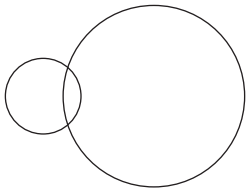
1 (d) Electrolysis of sodium chloride solution produces hydrogen and chlorine.
The hydrogen and chlorine can be used to make hydrogen chloride.

1 (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)

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

.....

(1 mark)

1 (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?

.....

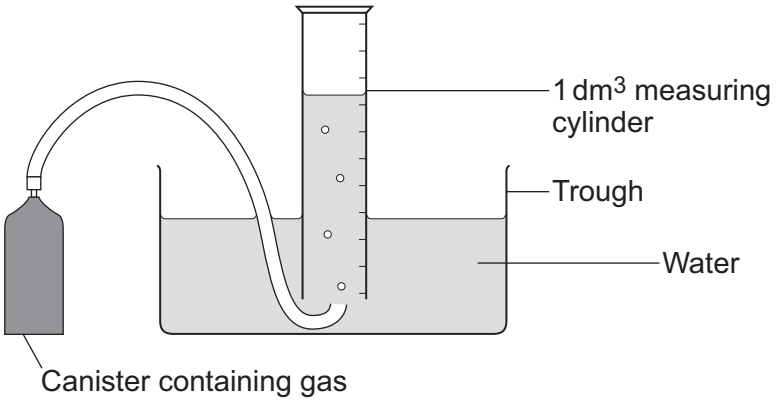
(1 mark)

6

Turn over for the next question

Do not write outside the box

2 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.

2 (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)

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

.....

.....

(1 mark)

Do not write outside the box

2 (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

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

.....

Mean = ...
(2 marks)

2 (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)

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

.....

.....
(1 mark)

2 (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.

.....

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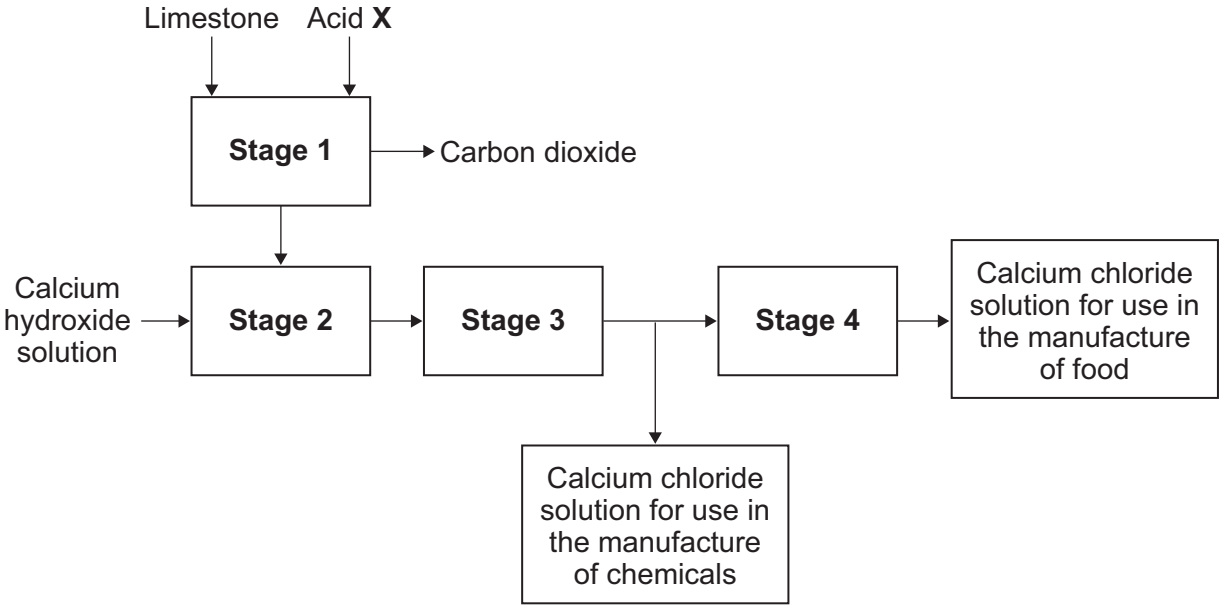
Relative formula mass = ...
(2 marks)

9

Turn over ▶

Do not write outside the box

3 (a) Calcium chloride is made from limestone. The limestone used contains mainly calcium carbonate and a small amount of magnesium carbonate.



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

Name acid **X**.

.....

(1 mark)

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

Calcium hydroxide solution is added to remove the magnesium chloride:

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

This is an example of a *precipitation* reaction.

What is the meaning of the term *precipitation* reaction?

.....

.....

(1 mark)

Do not write outside the box

3 (a) (iii) The magnesium hydroxide can be separated from the calcium chloride solution.

State how.

.....

.....

(1 mark)

3 (a) (iv) Suggest why **stage 4** is needed.

.....

.....

(1 mark)

3 (a) (v) Name a method that can be used to change calcium chloride solution into solid calcium chloride.

.....

(1 mark)

3 (b) Calcium chloride can also be made by reacting calcium with chlorine.

Calcium chloride is an ionic compound. It contains calcium ions (Ca^{2+}).

3 (b) (i) Complete the equation for the formation of calcium ions.

$$Ca \rightarrow Ca^{2+} + ...$$

(1 mark)

3 (b) (ii) Why can the formation of calcium ions from calcium atoms be described as oxidation?

.....

.....

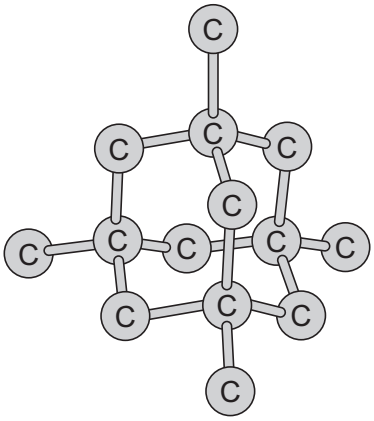
(1 mark)

7

Turn over for the next question

Do not write outside the box

4 Diamonds are used as abrasives.



Model of part of the diamond structure

Diamonds are very hard.
Explain why.

A good answer will include information on the structure and bonding in diamonds.

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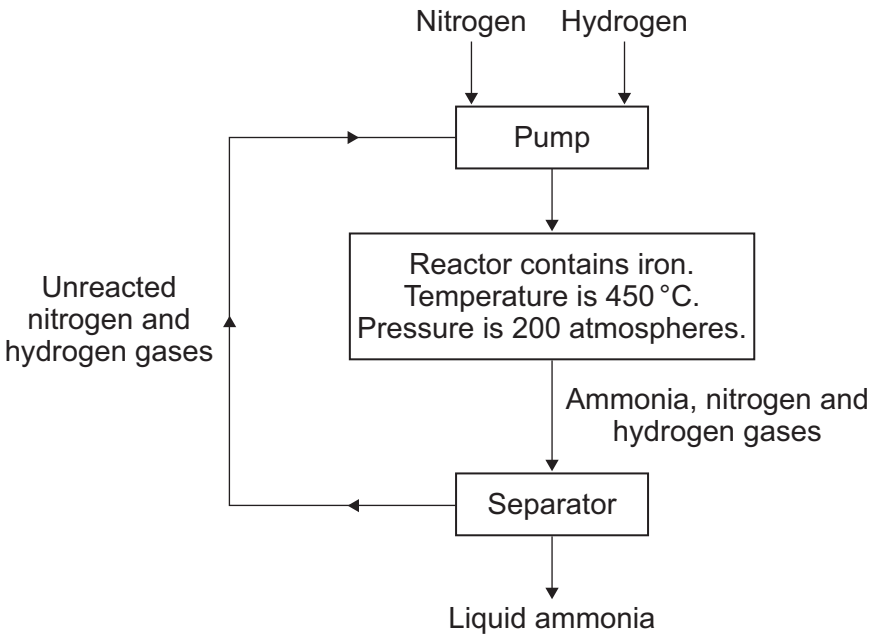
.....

(3 marks)

3

Do not write outside the box

5 Ammonia is made using the Haber process.



5 (a) How is ammonia separated from unreacted nitrogen and hydrogen in the separator?

.....

.....

.....

.....

(2 marks)

5 (b) The equation shows the reaction which takes place in the reactor:

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

5 (b) (i) Why does the yield of ammonia at equilibrium increase as the temperature is decreased?

.....

.....

(1 mark)

Question 5 continues on the next page

Turn over ▶

Do not write outside the box

5 (b) (ii) A temperature of 450 °C is used in the reactor to make the reaction take place quickly.

Explain, in terms of particles, why increasing the temperature makes a reaction go faster.

.....

.....

.....

.....

(2 marks)

5 (b) (iii) Why does the yield of ammonia at equilibrium increase as the pressure is increased?

.....

.....

(1 mark)

5 (b) (iv) The pressure used in the reactor is 200 atmospheres.
Suggest why a much higher pressure is **not** used.

.....

.....

(1 mark)

5 (c) Use the equation for the reaction in the reactor to help you to answer these questions.

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

5 (c) (i) It is important to mix the correct amounts of hydrogen and nitrogen in the reactor.

20 m^3 of nitrogen is reacted with hydrogen.

What volume of hydrogen (measured at the same temperature and pressure as the nitrogen) is needed to have the correct number of molecules to react with the nitrogen?

Volume of hydrogen needed = ... m^3

(1 mark)

Do not write outside the box

5 (c) (ii) Calculate the maximum mass of ammonia that can be made from 2 g of nitrogen.

Relative atomic masses: H = 1; N = 14.

.....

.....

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.....

.....

Maximum mass of ammonia = ... g

(3 marks)

5 (d) The expected maximum mass of ammonia produced by the Haber process can be calculated.

5 (d) (i) In one process, the maximum mass of ammonia should be 80 kg.

The actual mass of ammonia obtained was 12 kg.

Calculate the percentage yield of ammonia in this process.

.....

.....

Percentage yield of ammonia = ... %

(1 mark)

5 (d) (ii) Give **two** reasons why it does **not** matter that the percentage yield of ammonia is low. Use the flow diagram at the start of this question to help you.

.....

.....

.....

.....

(2 marks)

14

Turn over for the next question

Do not write outside the box

6 High quality connectors are used to connect a satellite box to a television.
The connectors should conduct electricity very well and should not corrode.



The connectors on this scart lead are coated with gold.

6 (a) Gold is a typical metal.

6 (a) (i) Describe the structure and bonding of gold.

.....

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.....

(3 marks)

6 (a) (ii) Why is gold a good conductor of electricity?

.....

.....

(1 mark)

Do not write outside the box

6 (b) The surface of some metals, such as iron, corrode when exposed to the air.

Suggest why this reduces the electrical conductivity of the metal.

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(2 marks)

6

END OF QUESTIONS

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Version: 10/08/2012



General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Mark Scheme

2012 examination - June series

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

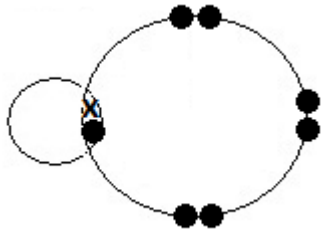
The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

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.

CHY2H

Question 1

question	answers	extra information	mark
1(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
1(b)	hydrogen is less reactive than sodium		1
1(c)	hydroxide (ions) / OH^-	ignore OH do **not** accept NaOH / sodium hydroxide	1
1(d)(i)		allow any combination of dots or crosses ignore chemical symbols	1
1(d)(ii)	covalent	allow close spelling errors apply list principle	1
1(d)(iii)	hydrogen (ion) / H^+	ignore (aq) / H do **not** accept hydrochloric acid / HCl apply list principle	1
Total			**6**

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CHY2H

Question 2

question	answers	extra information	mark
2(a)	1.86	ignore units / 1.9	1
2(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
2(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 2 continues on the next page . . .

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CHY2H

Question 2 cont'd…

question	answers	extra information	mark
2(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
2(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
2(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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CHY2H

Question 3

question	answers	extra information	mark
3(a)(i)	hydrochloric (acid) / HCl	allow phonetic spelling ignore incorrect formula ignore state symbols	1
3(a)(ii)	idea of a solid / insoluble substance being formed (from solutions)	accept solid / insoluble product ignore cloudy do **not** accept evaporation	1
3(a)(iii)	filtration / filter	accept decanting / centrifugation ignore evaporate if after filtering	1
3(a)(iv)	idea of making safe (to eat) **or** idea of purification **or** idea of neutralisation	allow remove harmful substances / organisms **or** sterilisation	1
3(a)(v)	crystallisation	accept evaporation / heating / boiling allow cooling do **not** allow freezing / solidifying	1
3(b)(i)	$2e^-$	accept $e^- + e^-$ ignore working out	1
3(b)(ii)	electron(s) are lost (from calcium atoms)	ignore numbers if given do **not** accept any reference to oxygen	1
Total			**7**

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CHY2H

Question 4

question	answers	extra information	mark
4	any **three** from: • giant structure / lattice / macromolecule • covalent (bonds) • bonds are (very) strong • each atom / carbon joined to <u>four</u> others	any reference to incorrect bonding = max 2 allow bonds difficult to break **or** takes a lot of energy to break bonds accept each atom / carbon forms <u>four</u> bonds	3
Total			**3**

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CHY2H

Question 5

question	answers	extra information	mark
5(a)	mixture is cooled / cooling so ammonia / it condenses **or** so ammonia turns into a liquid (but nitrogen and hydrogen remain as gases)		1 1
5(b)(i)	exothermic reaction **or** equilibrium / reaction moves in the direction which raises the temperature	accept reverse reaction is endothermic ignore answers based on rate or collisions	1
5(b)(ii)	they / particles / molecules move faster **or** have more (kinetic) energy any **one** from: • particles / molecules collide more often / more frequently / more likely to collide • more of the collisions are successful **or** particles collide with more energy / harder **or** more of the particles have the activation energy	allow atoms instead of particles ignore particles move more / vibrate do **not** accept electrons (max1) ignore collide faster ignore more collisions accept more successful collisions	1 1
5(b)(iii)	more molecules / particles / moles / volumes on LHS (of equation than RHS) **or** greater volume on LHS (than RHS) **or** equilibrium / reaction moves in the direction which reduces the pressure / volume	accept 4 molecules / particles / moles / volumes on LHS and 2 molecules / particles / moles / volumes on RHS accept converse	1

Question 5 continues on the next page . . .

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Question 5 cont'd…

question	answers	extra information	mark
5(b)(iv)	cost **or** difficulty in containing such a high pressure	allow risk of explosion ignore dangerous	1
5(c)(i)	60		1
5(c)(ii)	2.4(2857….)	correct answer gains **3** marks with or without working accept any answer that rounds to 2.4 ignore units if answer is incorrect look for evidence of correct working to a maximum of **2** marks. moles of N_2 = 2/28 = (0.0714) moles of ammonia = 2 x 0.0714 = (0.1428) mass of ammonia = 0.1428 x 17 = (2.4276) **or** 28 → 34 1g → 34/28 2g → 2.4…….	3
5(d)(i)	15		1
5(d)(ii)	unreacted gases are recycled rate (of production) is fast	allow unreacted gases are reused accept production is continuous ignore compromise between rate and yield	1 1
Total			**14**

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CHY2H

Question 6

question	answers	extra information	mark
6(a)(i)		mention of molecules **or** any reference to incorrect bonding = max 2	
	giant structure / lattice or particles arranged in a regular pattern	allow close packed / layers	1
	sea of electrons / delocalised electrons	allow free electrons	1
	positive ions and electrons attract each other	ignore metallic bonds appropriately labelled diagrams can gain first two marks	1
6(a)(ii)	(sea of) electrons can move through the structure **or** delocalised electrons	allow free / roaming / mobile electrons	1
6(b)	(metal) oxide / ionic compound formed		1
	ions not free to move **or** electrons cannot move through the structure	allow no / fewer delocalised / free / roaming / mobile electrons	1
Total			**6**

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Question	Mark
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TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Additional Science
Unit Chemistry C2

CHY2H

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Chemistry
Unit Chemistry C2

Written Paper

Thursday 26 January 2012 9.00 am to 9.45 am

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- the Data Sheet (enclosed).

You may use a calculator.

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

1 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.

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

.....

.....

(1 mark)

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

Explain why.

.....

.....

(1 mark)

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

.....

.....

(1 mark)

Do not write outside the box

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

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

(1 mark)

1 (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

2 Some students investigated magnesium oxide.

2 (a) Magnesium oxide has the formula MgO.

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

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

.....

.....

Relative formula mass = ...

(2 marks)

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

.....

.....

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

(2 marks)

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

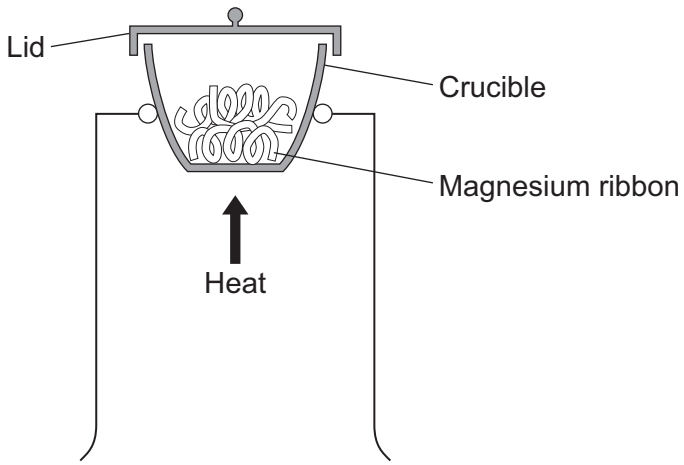
.....

Mass of magnesium = ... g

(1 mark)

2 (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

2 (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)

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

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

.....

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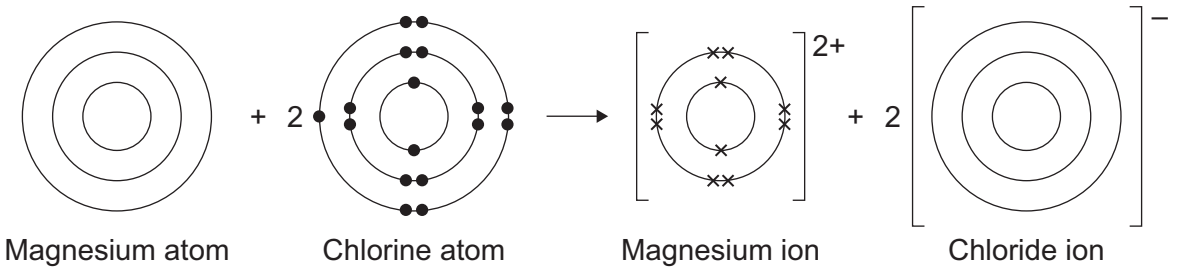
(2 marks)

9

Do not write outside the box

3 Magnesium reacts with chlorine to make the ionic compound called magnesium chloride.

3 (a) Complete the diagram by adding the electronic structures of the magnesium atom and the chloride ion.



Magnesium atom Chlorine atom Magnesium ion Chloride ion

(2 marks)

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

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

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

Name a method that could be used to separate magnesium hydroxide from the solution.

.....

(1 mark)

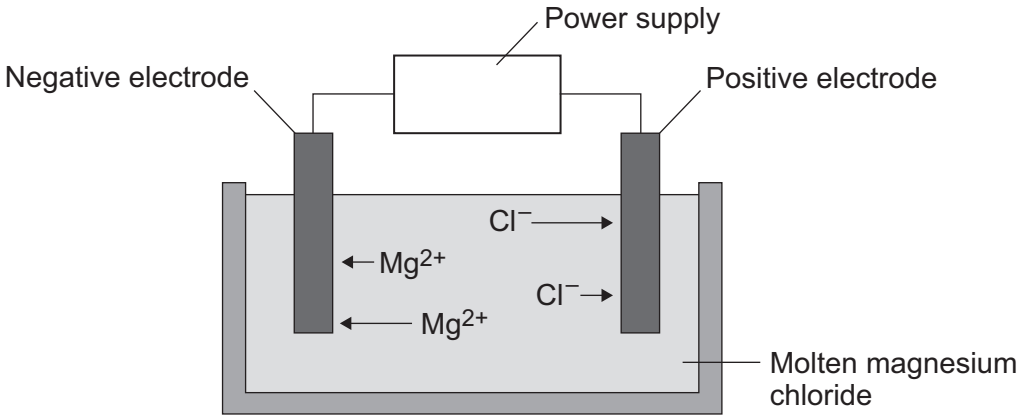
3 (b) (ii) An acid is then added to the magnesium hydroxide to make magnesium chloride.

Name this acid. .....

(1 mark)

Do not write outside the box

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



3 (c) (i) Why must the magnesium chloride be molten?

.....

.....

(1 mark)

3 (c) (ii) The equation shows the reaction that takes place at the positive electrode.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

Why is this reaction an oxidation reaction?

.....

(1 mark)

3 (c) (iii) Complete the equation for the reaction at the negative electrode.

$$Mg^{2+} \rightarrow Mg$$

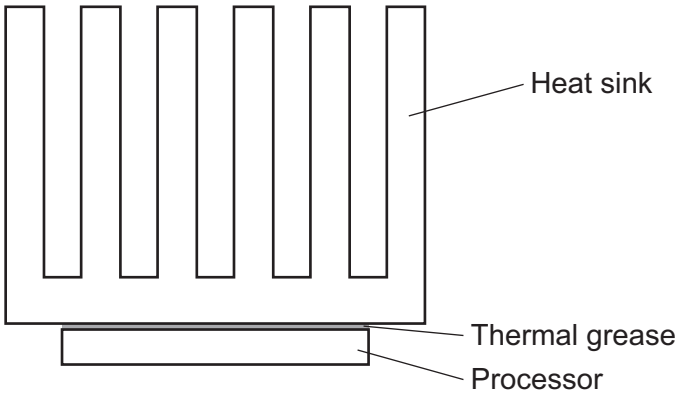
(1 mark)

7

Turn over for the next question

Do not write outside the box

4 The diagram shows how a heat sink is placed on top of a processor in a computer. The heat sink is a large piece of metal which conducts heat away from the processor. If the processor gets too hot it may be damaged.



4 (a) (i) Describe the structure of a metal.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

4 (a) (ii) Why are metals very good conductors of heat?

.....

.....

(1 mark)

Do not write outside the box

4 (b) When viewed under a microscope, it can be seen that the surfaces of the processor and the heat sink that are in contact are not flat.
There are lots of tiny gaps between the two surfaces.
The gaps contain air, which does not conduct heat very well.
Thermal grease is used to fill the gaps between the processor and the heat sink to improve the transfer of heat from the processor to the heat sink.

One type of thermal grease contains nanosized particles of silver.
The manufacturer claims that the nanosized particles help to transfer heat better than normal sized particles.

4 (b) (i) How are nanosized particles different from normal sized particles?

.....

.....

(1 mark)

4 (b) (ii) Suggest **one** reason why nanosized particles of silver might help to transfer heat better than normal sized particles.

.....

.....

(1 mark)

6

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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5 The picture shows a painting which was painted in a cave in France about 17 000 years ago.



One of the pigments in this painting contains:

70 % of iron (Fe) and 30 % of oxygen (O)

Calculate the simplest (empirical) formula of this substance.

Relative atomic masses: O = 16; Fe = 56.

.....

.....

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.....

(4 marks)

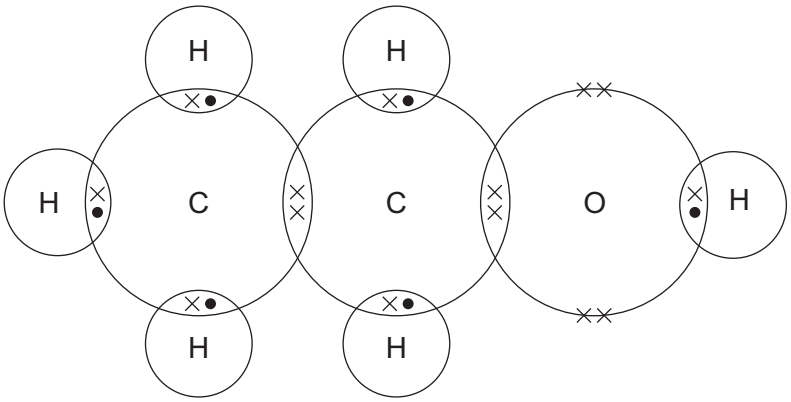
4

Turn over for the next question

Do not write outside the box

6 Ethanol, C_2H_5OH, is used as a solvent.

6 (a) The diagram represents the arrangement of electrons in a molecule of ethanol.

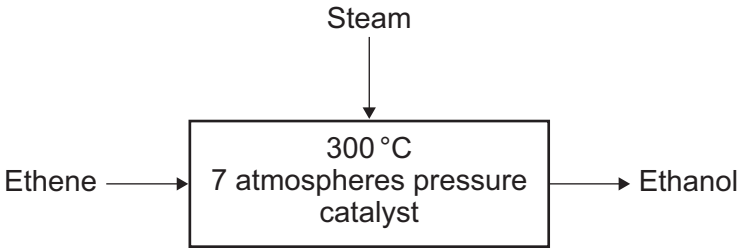


State the type of bonding between the atoms in an ethanol molecule.

.....

(1 mark)

6 (b) Ethanol can be made by the reaction of ethene with steam.



The equation for this reaction is shown below.

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

The forward reaction is exothermic.

6 (b) (i) Why does an increase in pressure increase the yield of ethanol at equilibrium?

.....

.....

.....

(1 mark)

Do not write outside the box

6 (b) (ii) Why does an increase in temperature decrease the yield of ethanol at equilibrium?

.....

.....

(1 mark)

6 (c) As the pressure increases, the rate of reaction increases.

Explain why.

.....

.....

.....

.....

(2 marks)

6 (d) Ethanol has a low boiling point and evaporates easily.

Explain why.

.....

.....

.....

.....

(2 marks)

7

Turn over for the next question

Do not write outside the box

7 Scientists have recently developed a method to produce large sheets of a substance called graphene.
Graphene is made from carbon and is a single layer of graphite just one atom thick.

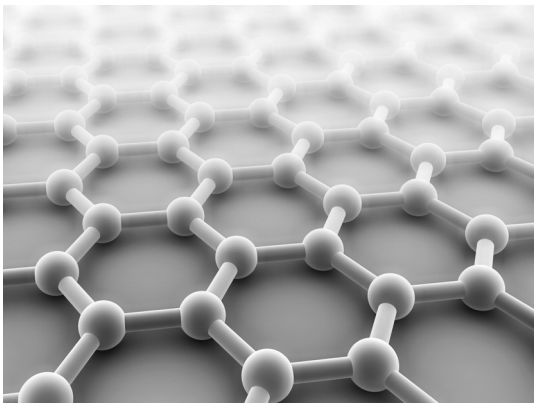
The properties of graphene include:

- it conducts electricity
- it is transparent since it is only one atom thick
- it is strong and durable.



These properties make it suitable to overlay a monitor screen to make it a touchscreen.

The photograph below shows the structure of graphene.



Source: photograph © Pasieka / Science Photo Library

Use your knowledge of the bonding in graphite and the photograph of the structure to help you to explain, as fully as you can:

7 (a) (i) why graphene is strong;

.....

.....

.....

.....

.....

.....

(3 marks)

Do not write outside the box

7 (a) (ii) why graphene conducts electricity.

.....

.....

.....

.....

.....

(2 marks)

7 (b) Suggest why a sheet of graphite which has a large number of carbon layers would not be suitable for the touchscreen.

.....

.....

(1 mark)

6

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

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Version : 07/03/2012



General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Mark Scheme

2012 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 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	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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CHY2H

Question 1

question	answers	extra information	mark
1(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
1(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
1(c)	reaction is endothermic **or** reaction takes in heat / energy	accept activation energy ignore rate / high temperature ignore bonds broken	1
1(d)	(aluminium chloride + potassium) → aluminium + potassium chloride	in either order accept correct formulae ignore metal ignore balancing	1
1(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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CHY2H

Question 2

question	answers	extra information	mark
2(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
2(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
2(a)(iii)	15	ecf allowed from parts(i) and (ii) 24/(i) x 25 or (ii)/100 x 25 ignore units	1
2(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 2 continues on the next page……

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CHY2H

Question 2 continued

question	answers	extra information	mark
2(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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CHY2H

Question 3

question	answers	extra information	mark
3(a)	2.8.2 (drawn as dots or crosses on the circles) 2.8.8 (drawn as dots or crosses on the circles)	ignore any attempts to change the charge on chloride ion accept e instead of dots or crosses	1 1
3(b)(i)	filtration	accept decanting or centrifugation do **not** accept evaporation	1
3(b)(ii)	hydrochloric	accept HCl	1
3(c)(i)	so that ions / particles can move (in electrolyte)	allow so it can conduct electricity / carry charge / carry current ignore reference to electrons moving in the external circuit any unqualified reference to electrons moving / carrying charge / carrying current = **0** marks	1
3(c)(ii)	electrons are lost	ignore numbers	1
3(c)(iii)	+ $2e^-$ on left hand side of equation	must be correct with no other additions accept correct multiples	1
Total			**7**

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CHY2H

Question 4

question	answers	extra information	mark
4(a)(i)		mention of molecules / intermolecular / ionic / covalent = **max 2**	
	atoms / positive ions		1
	any **two** from:		2
	• (atoms / positive ions) in regular pattern / lattice / layer / giant structure (or diagram)		
	• delocalised electrons	accept electrons move within / through the structure allow free (moving) electrons allow sea of electrons	
	• (atoms / positive ions) held together by strong / electrostatic attractions	allow strong (metallic) bonds	
4(a)(ii)	delocalised electrons	accept electrons move within / through the structure allow free electrons	1
4(b)(i)	smaller / very small	accept converse accept 1 – 100 nanometres in size accept a few hundred atoms accept larger surface area **or** large surface area for their size	1
4(b)(ii)	nanoparticles / more can fit into (tiny) gaps	allow nanosize particles have large(r) surface area	1
Total			**6**

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Question 5

question	answers		extra information	mark
5	70/56	30/16	division by atomic mass	1
	= 1.25	= 1.875	proportion	1
	2	3	ratio (accept 1:1.5 / 4:6 / etc) allow e.c.f from proportion if sensible attempt at step 1	1
	Fe_2O_3		formula allow e.c.f from ratio if sensible attempt at step 1 allow correct formula with no working = **1** mark	1
Total				**4**

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Question 6

question	answers	extra information	mark
6(a)	covalent		1
6(b)(i)	2 molecules / particles on the left (of the equation) and one on the right **or** 2 volumes on the left and one on the right **or** the reaction results in a decrease in the number of molecules	allow the reaction moves in the direction which opposes the increase in pressure ignore reference to rate / collisions / exothermic	1
6(b)(ii)	the (forward) reaction is exothermic **or** the reverse / backward reaction is endothermic	allow the reaction moves in the direction which opposes the increase in temperature	1
6(c)	because particles / molecules are closer together so collisions are more frequent **or** (particles) collide more often	accept increases the concentration do **not** accept atoms / electrons ignore collide faster / quicker **or** more successful collisions do **not** accept particles have more energy or move faster	1 1

Question 6 continues on the next page……

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CHY2H

Question 6 continued

question	answers	extra information	mark
6(d)	forces of attraction / bonds between molecules are weak **or** intermolecular forces / bonds are weak	accept it is made of small molecules with weak forces of attraction for **2** marks do **not** accept intramolecular forces / covalent bonds are weak do **not** accept reference to ions do **not** accept intermolecular forces between atoms if 2 marks not awarded made of small molecules / simple molecular gains **1** mark forces of attraction are weak (without specifying between molecules / intermolecular) gains **1** mark ignore bonds are weak	2
Total			**7**

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CHY2H

Question 7

question	answers	extra information	mark
7(a)(i)		ionic / molecules / metallic / (inter)molecular = max **2**	
	because graphene / it has a giant structure / lattice / macromolecular	accept all / every / each atom is bonded to 3 other atoms	1
	because graphene / it has covalent bonds / is covalent		1
	because in graphene / it the bonds are strong **or** a lot of energy needed / hard to break the bonds		1
7(a)(ii)	there are delocalised / free electrons		1
	because one (delocalised / free) electron per atom linked to first marking point	accept because three electrons per atom used (in bonding) accept because one electron per atom not used (in bonding)	1
7(b)	opaque (owtte) **or** layers slide **or** layers not aligned	eg could not see through them ignore thick	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
Higher Tier
June 2011

Additional Science
Unit Chemistry C2

CHY2H

H

Chemistry
Unit Chemistry C2

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 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.

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

.....

.....

(1 mark)

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

.....

(1 mark)

Do not write outside the box

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

Suggest why.

.....

.....

(1 mark)

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

Use the information in the article to explain why.

.....

.....

.....

.....

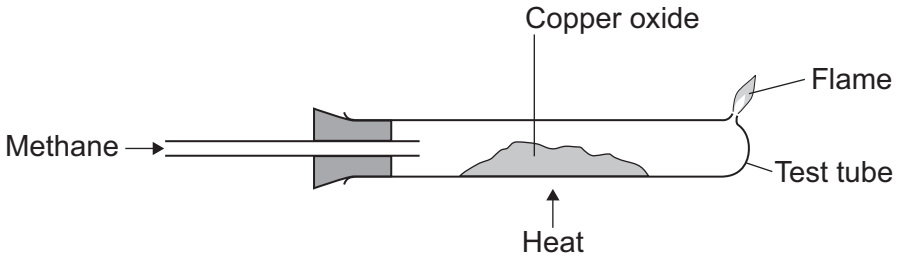
(2 marks)

5

Turn over for the next question

Do not write outside the box

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



2 (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)

2 (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)

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

.....

.....

.....

Percentage of copper = ... %

(2 marks)

Do not write outside the box

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

.....

.....

Mass of copper = ... g

(1 mark)

2 (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

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

.....

.....

Mean mass of copper made = ... g

(1 mark)

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

.....

.....

(1 mark)

2 (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

Turn over ▶

Do not write outside the box

There are no questions printed on this page

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3 The picture shows lumps of phosphate rock.



Phosphoric acid is made by adding sulfuric acid to phosphate rock.

3 (a) The rate of reaction between sulfuric acid and phosphate rock can be increased if the mixture is heated to a higher temperature.

Explain, in terms of particles, why an increase in temperature increases the rate of reaction.

.....

.....

.....

.....

.....

.....

(2 marks)

3 (b) State **one** other way in which the rate of reaction between sulfuric acid and phosphate rock can be increased.

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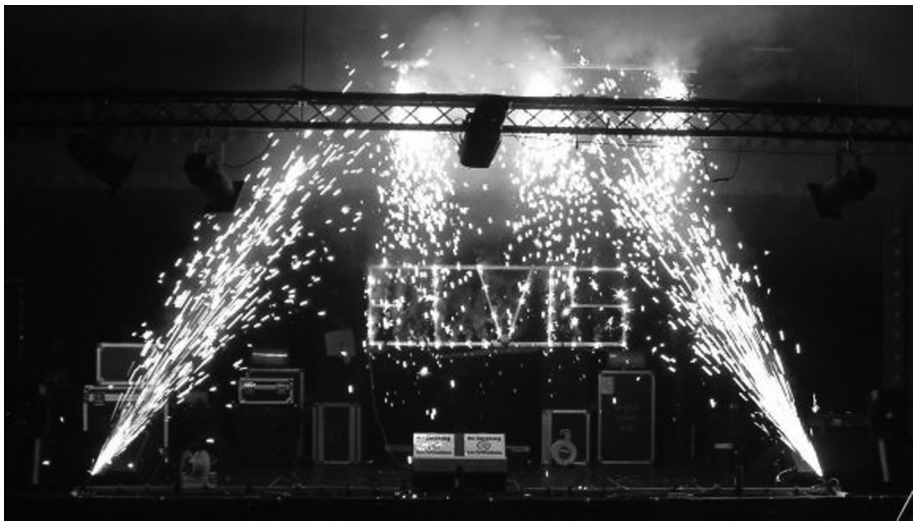
(1 mark)

3

Do not write outside the box

4 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.

4 (a) When aluminium burns the reaction is *exothermic*.

What is the meaning of *exothermic?*

.....

.....

(1 mark)

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

What is the name given to the heat energy needed to start a chemical reaction?

..... energy

(1 mark)

Do not write outside the box

4 (c) The white smoke produced is aluminium oxide.

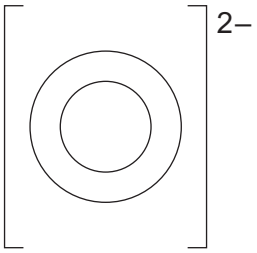
Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

4 (c) (i) Complete the diagram to show the electronic structure of an oxide ion.

The atomic number of oxygen = 8

Use crosses (x) to represent the electrons.

oxide ion



(1 mark)

4 (c) (ii) The bonding in aluminium oxide is ionic.

What causes the aluminium ions and oxide ions to be held together strongly?

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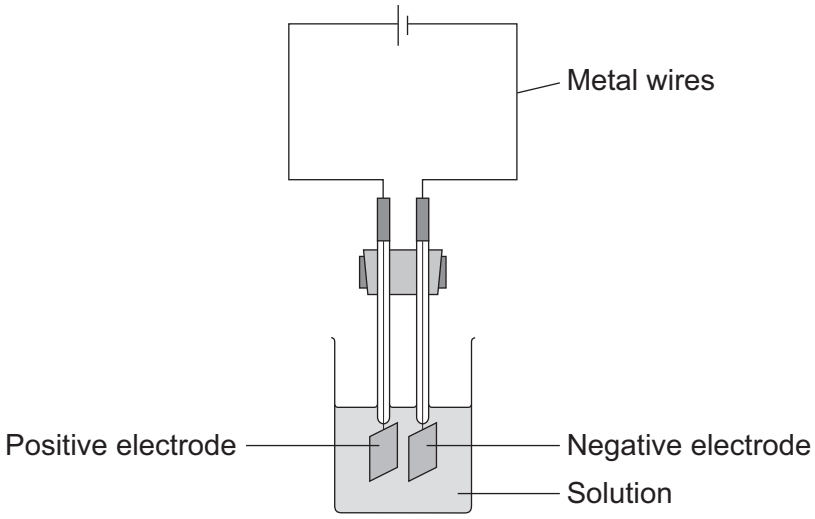
(1 mark)

4

Turn over for the next question

Do not write outside the box

5 The diagram shows apparatus used by a student to investigate electrolysis.



The student was given a solution by the teacher. The solution contained a mixture of ionic compounds.

5 (a) Name the particles which carry the electric current through:

5 (a) (i) the metal wires.....

(1 mark)

5 (a) (ii) the solution. .....

(1 mark)

5 (b) The table shows the ions in the solution.

Positive ions in the solution	Negative ions in the solution
Zinc ion (Zn^{2+})	Chloride ion (Cl^{-})
Iron(III) ion (Fe^{3+})	Hydroxide ion (OH^{-})
Hydrogen ion (H^{+})	Nitrate ion (NO_3^{-})
Copper(II) ion (Cu^{2+})	Sulfate ion (SO_4^{2-})

The reactivity series on the Data Sheet may help you to answer this question.

5 (b) (i) Which element is most likely to be formed at the negative electrode?

.....

(1 mark)

Do not write outside the box

5 (b) (ii) Explain, as fully as you can, why you have chosen this element.

.....

.....

.....

.....

(2 marks)

5 (c) The electrolysis of sodium chloride solution is an industrial process.

5 (c) (i) The reaction at one of the electrodes can be represented by the equation shown below.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

The chloride ions (Cl^-) are oxidised.

Explain why.

.....

.....

(1 mark)

5 (c) (ii) The reaction at the other electrode can be represented by an equation.

Complete and balance the equation for the reaction at the other electrode.

$$H^+ \rightarrow H_2$$

(1 mark)

7

Turn over for the next question

Do not write outside the box

6 Lead compounds have been used for thousands of years as colours in paint.



6 (a) A sample of a red oxide used in paint was found to contain 6.21 g of lead and 0.64 g of oxygen.

Calculate the empirical (simplest) formula of this compound.

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

Relative atomic masses: O = 16; Pb = 207.

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(4 marks)

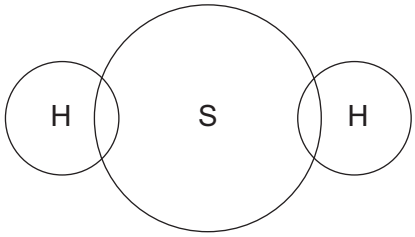
Do not write outside the box

6 (b) A problem with lead compounds is that they slowly react with hydrogen sulfide in the air. This produces lead sulfide which is black.

6 (b) (i) Hydrogen sulfide has the formula H_2S. The bonding in a molecule of hydrogen sulfide can be represented as:

H–S–H

Complete the diagram below to show the arrangement of the outer electrons of the hydrogen and sulfur atoms in hydrogen sulfide.
Use dots (•) and crosses (x) to represent the electrons.
You need only show the outer shell electrons.
(Atomic numbers: H = 1; S = 16.)



(1 mark)

6 (b) (ii) Hydrogen sulfide has a low boiling point.

Explain why.

.....

.....

.....

.....

(2 marks)

6 (b) (iii) Lead white is also used in paint. The white colour slowly darkens when lead sulfide is produced.

The painting can be restored with hydrogen peroxide. This converts the black lead sulfide into white lead sulfate.

Balance the equation for the reaction between lead sulfide and hydrogen peroxide (H_2O_2).

$$PbS(s) + ...H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$$

(1 mark)

8

Turn over ▶

Do not write outside the box

7 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.



7 (a) The Haber process is used to make ammonia (NH_3).

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

The forward reaction is exothermic.

7 (a) (i) Name the raw materials that are used to supply the nitrogen and hydrogen.

Nitrogen .....

Hydrogen .....

(2 marks)

Do not write outside the box

7 (a) (ii) The Haber process uses a temperature of 450 °C.

Explain, as fully as you can, why a temperature of 450 °C is used rather than a much higher temperature or a much lower temperature.

.....

.....

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(3 marks)

7 (a) (iii) Ammonia can be converted to ammonium nitrate by adding an acid.

Name this acid.

.....

(1 mark)

7 (b) Suggest and explain why the invention of the Haber process caused the closure of the Humberstone mines in Chile.

.....

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(2 marks)

8

END OF QUESTIONS

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Version: 04/08/2011



General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H 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.

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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CHY2H

Question 1

question	answers	extra information	mark
1(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
1(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
1(c)	any **one** from: • big(ger) surface area • react fast(er)	 accept more reactive ignore kill faster	1
1(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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CHY2H

Question 2

question	answers	extra information	mark
2(a)	because they are gases	ignore vapours / evaporate / (g) allow it is a gas	1
2(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
2(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
2(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 2 continues on the next page

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Question 2 continued

question	answers	extra information	mark
2(c)(i)	3.3	accept 3.33…….. or $3\frac{1}{3}$ or $3.3^{\bullet}$ or 3.3^{r}	1
2(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
2(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**

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CHY2H

Question 3

question	answers	extra information	mark
3(a)	particles move faster **or** particles have more energy so they collide more often / frequently **or** more of the collisions are successful / have the activation energy	accept molecules / atoms / ions instead of particles ignore move / vibrate more allow particles collide harder / with more force ignore collide quicker ignore collide more / more collisions	1 1
3(b)	any **one** from: • increase surface area (of the rock) • increase the concentration (of the acid) • add a catalyst • stir / mix the mixture	 accept crush / powder the rock ignore increase the pressure / temperature	1
Total			**3**

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CHY2H

Question 4

question	answers	extra information	mark
4(a)	gives out heat / energy **or** energy / heat transferred to surroundings	allow more energy given out in making bonds than is used in breaking bonds ignore light	1
4(b)	activation	allow phonetic spelling	1
4(c)(i)	2 crosses on inner circle **and** 8 crosses on outer circle	accepts dots / e / ─ for electrons	1
4(c)(ii)	opposite charges (attract)	allow electrostatic forces (attract) do **not** accept intermolecular attraction / shared electrons	1
Total			**4**

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CHY2H

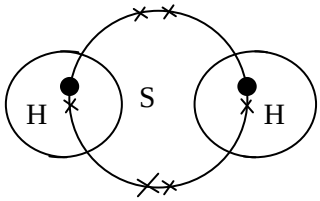
Question 5

question	answers	extra information	mark
5(a)(i)	electron(s)	allow free / delocalised / negative electrons do **not** accept additional particles	1
5(a)(ii)	ion(s)	allow named ions from table ignore positive or negative do **not** accept additional particles	1
5(b)(i)	copper	accept Cu do **not** accept Cu^{2+}	1
5(b)(ii)	it is / they are positive (ions) and it is the least reactive	accept formula of positive ion	1 1
5(c)(i)	loss of electron(s)	ignore numbers	1
5(c)(ii)	$\mathbf{2H^+} + \mathbf{2e^-} \rightarrow H_2$	accept correct multiples / fractions accept e / e^- allow $\mathbf{2H^+} \rightarrow H_2 - \mathbf{2e^-}$	1
Total			**7**

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CHY2H

Question 6

question	answers	extra information	mark
6(a)	$\frac{6.21}{207}$ $\quad$ $\frac{0.64}{16}$	**1** mark for dividing mass by A_r max **2** if A_r divided by mass	1
	= 0.03 $\quad$ = 0.04	**1** mark for correct proportions	1
	3 $\quad$ 4	**1** mark for correct whole number ratio (allow multiples) can be awarded from correct formula	1
	Pb_3O_4	**1** mark for correct formula **ecf** allowed from **step 2 to step 3** and **step 3 to step 4** if sensible attempt at **step 1** correct formula with no working gains **2** marks	1
6(b)(i)		allow all dots **or** all crosses **or** e **or** e^- ignore inner shells and any inner electrons allow 4 non-bonded electrons anywhere on shell as long as not in overlap – need not be paired	1

Question 6 continue on the next page

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Question 6 continued

question	answers	extra information	mark
6(b)(ii)	forces of attraction / bonds <u>between</u> molecules are weak (owtte) **or** <u>intermolecular</u> forces / bonds are weak (owtte) **or** it is made of small molecules with weak forces of attraction	do **not** accept intramolecular forces / covalent bonds are weak do **not** accept reference to ions if **2** marks not awarded made of small molecules / simple molecular gains **1** mark forces of attraction are weak (without specifying between molecules / intermolecular) gains **1** mark (accept easily broken / not much energy needed to break instead of weak) bonds are weak without specifying intermolecular would not gain a mark and would be ignored	2
6(b)(iii)	4		1
Total			**8**

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Question 7

question	answers	extra information	mark
7(a)(i)	nitrogen – air	accept atmosphere	1
	hydrogen – north sea gas / natural gas / methane / CH_4	accept water / (crude) oil / coal / hydrocarbons / brine	1
7(a)(ii)		allow converse throughout	
	• high temperature gives a low yield		1
	• because reaction is exothermic	must be linked to first bullet point	1
	• but at low temperatures the rate is (too) slow		1
		if no other marks awarded accept 450°C is a compromise between yield and rate **or** 450°C gives a reasonable yield in a reasonable time for **1** mark	
7(a)(iii)	nitric (acid)	accept HNO_3	1
7(b)	Ammonia / Haber process can be used to make fertiliser		1
	with a specified economical reason eg raw materials for Haber process readily available eg transport costs are lower or no need to import eg Haber process is a continuous process	ignore employment / labour costs	1
Total			**8**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
January 2011

Additional Science
Unit Chemistry C2

CHY2H

H

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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ANSWER IN THE SPACES PROVIDED

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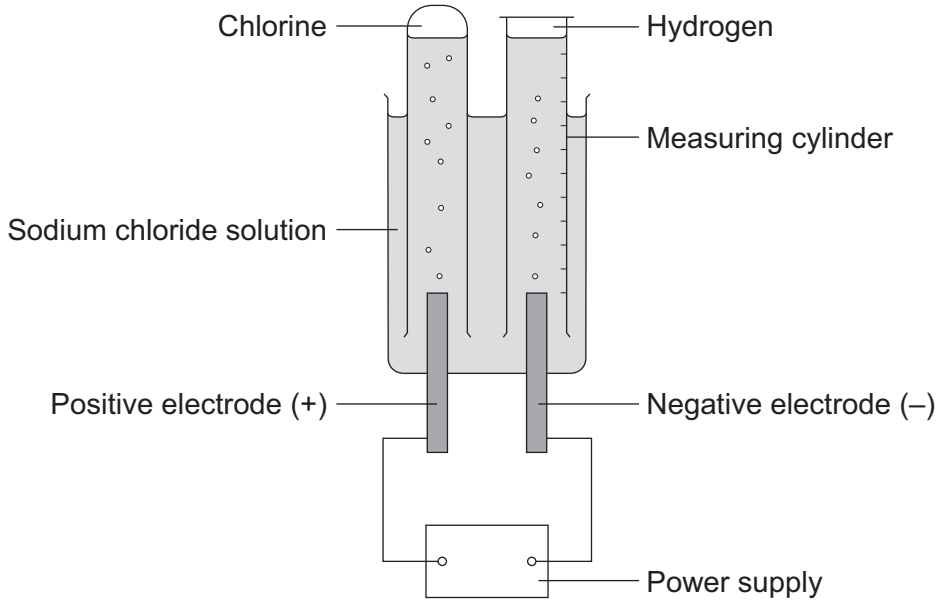
1 A student investigated the electrolysis of sodium chloride solution.

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.

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

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

.....

.....

(1 mark)

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

Why are chloride ions attracted to the positive electrode?

.....

(1 mark)

Question 1 continues on the next page

Turn over ▶

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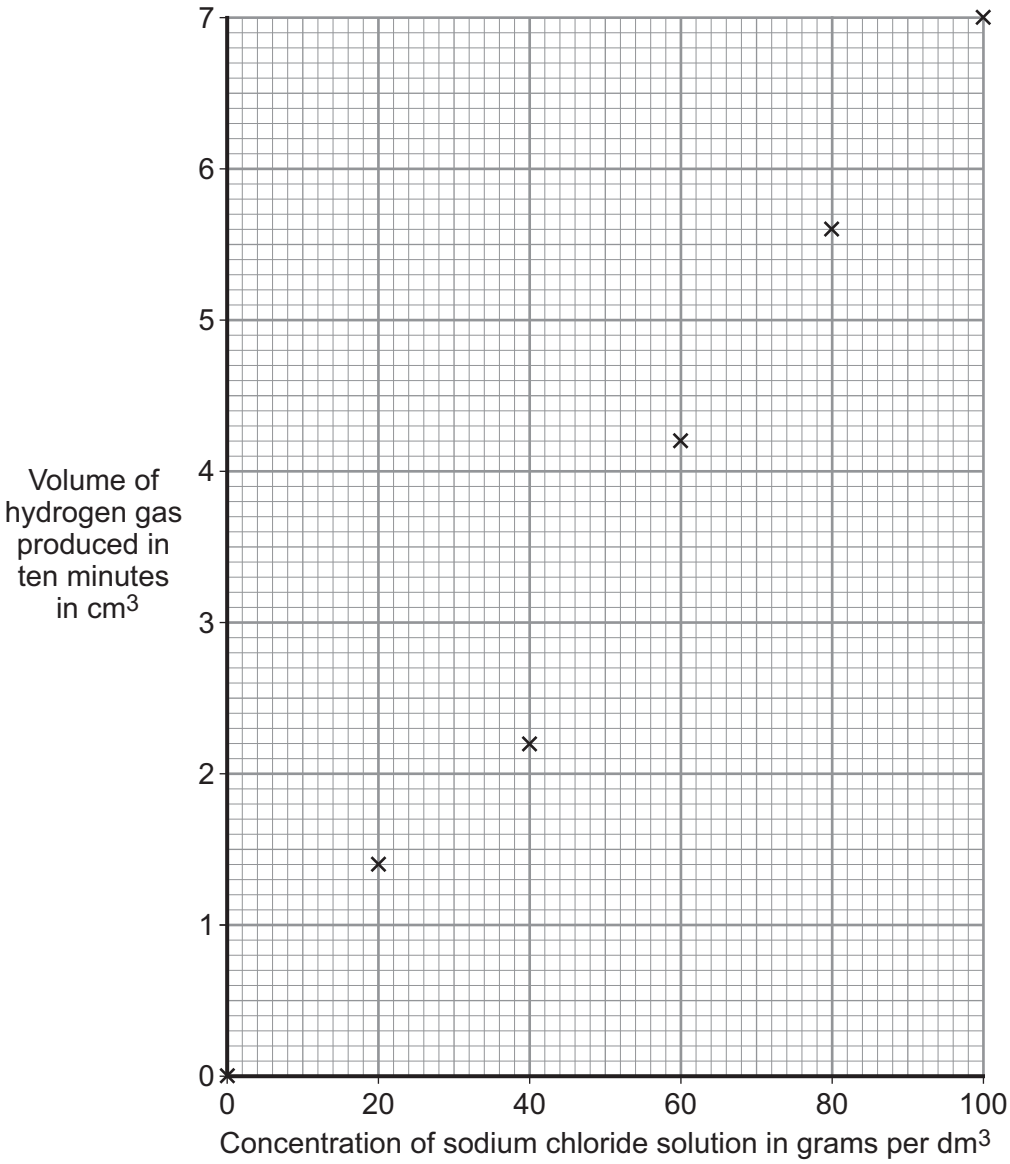
1 (c) The solution left at the end of each experiment contains sodium hydroxide.

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

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

(1 mark)

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



Do not write outside the box

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

(1 mark)

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

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

(1 mark)

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

1 .....

.....

2 .....

.....

(2 marks)

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

.....

.....

(1 mark)

1 (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

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



2 (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.

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

.....

.....

.....

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

2 (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

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

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

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

.....

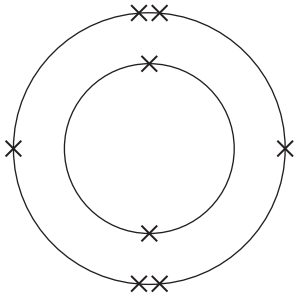
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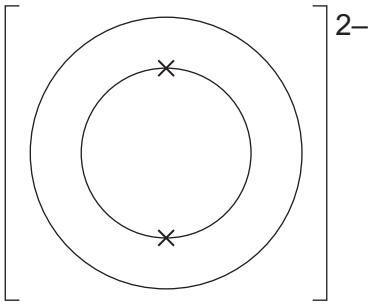
.....

(2 marks)

2 (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-}).



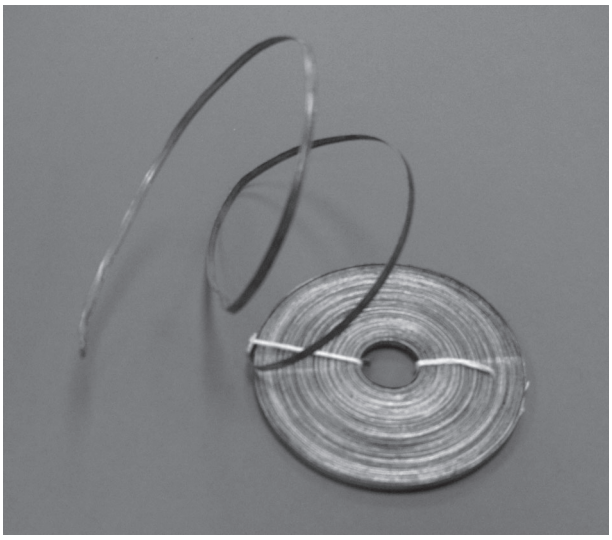
(1 mark)

6

Turn over for the next question

Do not write outside the box

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



Explain why metals can be shaped.

.....

.....

.....

.....

.....

(2 marks)

3 (b) 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:

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

3 (b) (i) Name the acid used to make magnesium sulfate.

..... acid

(1 mark)

Do not write outside the box

3 (b) (ii) Use the equation to help you to describe what you would **observe** when magnesium reacts with the acid.

.....

.....

.....

.....

.....

(2 marks)

3 (b) (iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

.....

.....

(1 mark)

6

Turn over for the next question

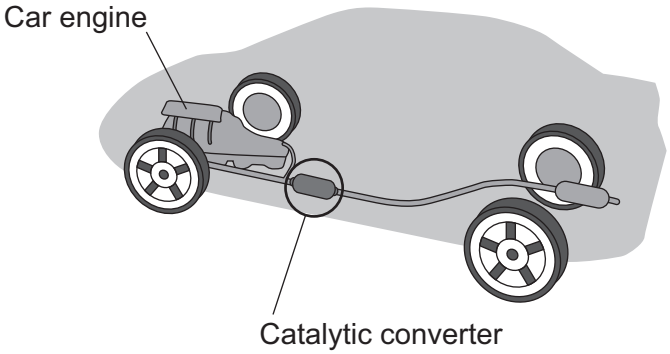
Do not write outside the box

4 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.



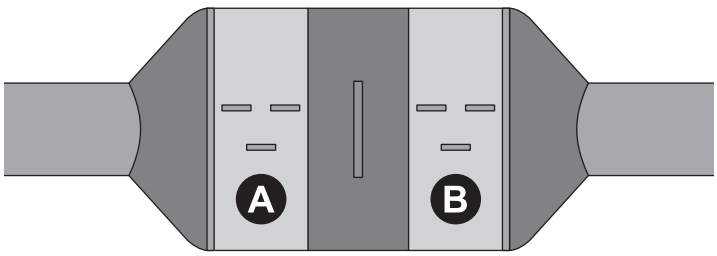
4 (a) The reaction is *exothermic*. What is the meaning of *exothermic*?

.....

.....

(1 mark)

4 (b) The catalytic converter has two parts shown as **A** and **B** in the diagram.



Part **A** contains a catalyst made from platinum and rhodium.

Part **B** contains a catalyst made from platinum and palladium.

Do not write outside the box

4 (b) (i) Why are catalysts used in chemical reactions?

.....

.....

(1 mark)

4 (b) (ii) One reaction in part **A** is shown by this equation.

$$2NO \rightarrow N_2 + O_2$$

Suggest why this reaction helps the environment.

.....

.....

(1 mark)

4 (b) (iii) The equation for one of the reactions in part **B** is shown below.

Balance this equation.

..... CO + O_2 → ..... CO_2

(1 mark)

4 (b) (iv) The catalytic converter works for many years without replacing the catalyst.

Explain why the catalyst does not need to be replaced.

.....

.....

(1 mark)

4 (b) (v) Suggest why different catalysts are used in parts **A** and **B**.

.....

.....

(1 mark)

Question 4 continues on the next page

Do not write outside the box

4 (c) Modern catalytic converters contain nanosized particles of catalyst. Using nanosized particles reduces the cost of the catalytic converter.

Suggest and explain why the use of nanosized catalyst particles reduces the cost of the catalytic converter.

Your answer should include information about the size and surface area of the particles.

.....

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.....

.....

(3 marks)

9

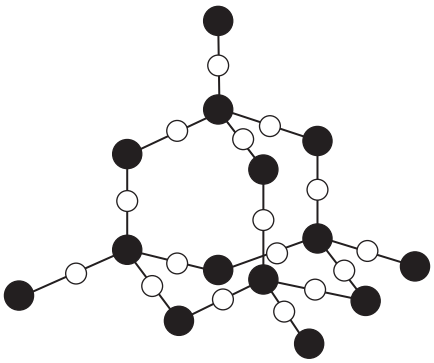
Do not write outside the box

5 Welding blankets are placed under metals being welded. They protect the area under the welding.

Photograph is not reproduced here due to third-party copyright constraints.

Some welding blankets are made from silicon dioxide which does not melt when hit by sparks or molten metal.

The diagram shows a small part of the structure of silicon dioxide.



Key
○ Oxygen atom
● Silicon atom

Describe the structure and bonding in silicon dioxide **and** explain why it is a suitable material for making welding blankets.

.....

.....

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.....

(3 marks)

3

Turn over ▶

Do not write outside the box

6 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.

6 (a) (i) Why is using methanol an advantage to the artist?

.....

.....

(1 mark)

6 (a) (ii) The bonds within a methanol molecule are strong, covalent bonds.

Explain why methanol has a low boiling point.

.....

.....

.....

.....

.....

(2 marks)

Do not write outside the box

6 (b) Methanol is made by reacting carbon monoxide with hydrogen.

The equation for this reaction is:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The forward reaction is exothermic.

The best equilibrium yield of methanol is obtained when the temperature is low and when the pressure is high.

Explain why the best equilibrium yield is obtained:

6 (b) (i) when the temperature is low

.....

.....

(1 mark)

6 (b) (ii) when the pressure is high.

.....

.....

(1 mark)

6 (b) (iii) In industry a high temperature is used for this reaction. This gives a fast rate of reaction. The increase in temperature gives the particles more energy.

Explain, in terms of particles, why this makes the reaction go faster.

.....

.....

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

Do not write outside the box

6 (c) (i) Calculate the maximum mass of methanol that could be made from 14 g of carbon monoxide.

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$$

Relative formula masses (M_r): CO = 28; CH_3OH = 32.

.....

.....

.....

.....

.....

Maximum mass of methanol = ... g

(2 marks)

6 (c) (ii) In an experiment the actual mass of methanol made from 14 g of carbon monoxide was 12 g. Use this information and your answer from part (c)(i) to calculate the percentage yield of methanol in this experiment.

(If you did not get an answer to part (c)(i) then assume that the maximum yield is 18 g. This is **not** the correct answer to part (c)(i).)

.....

.....

Percentage yield of methanol = ...%

(2 marks)

6 (c) (iii) Suggest **one** reason why the yield obtained is less than the maximum yield.

.....

.....

(1 mark)

12

END OF QUESTIONS

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Question 6: Photograph © Howard Lewin

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Version : 08/03/2011

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H 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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CHY2H

Question 1

question	answers	extra information	mark
1(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
1(b)	any **one** from: • because they are negative / anion • opposite charges / attract	allow Cl^- ignore chlorine	1
1(c)	13		1
1(d)(i)	reasonable attempt at straight line which misses the anomalous point	must touch all five crosses do **not** allow multiple lines	1
1(d)(ii)	40	ignore 2.2	1

Question 1 continues on the next page

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CHY2H

Question 1 contd

question	answers	extra information	mark
1(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
1(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
1(d)(v)	increases owtte	allow directly proportional or positive correlation allow rate / it is faster / quicker	1
Total			**9**

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CHY2H

Question 2

question	answers	extra information	mark
2(a)(i)	65	correct answer with or without working = **2** marks if answer incorrect evidence of (81 – 16) for **1** mark ignore units	2
2(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
2(b)(i)	• it loses electrons • three electrons	sharing / covalency = max **1** mark	1 1
2(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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CHY2H

Question 3

question	answers	extra information	mark
3(a)	• made of layers / rows (atoms / ions / particles) • which can slide / slip (over each other) **or** particles / ions / atoms can slide over each other	ignore free / delocalised electrons reference to incorrect particles / covalency / intermolecular forces = max **1** ignore malleable / ductile / weak bonds	1 1
3(b)(i)	sulfuric	accept sulphuric ignore formula ignore hydrogen sulfate	1
3(b)(ii)	any **two** from: • (hydrogen) gas produced (or any indication of a gas such as bubbles etc.) • magnesium / solid disappears / goes into solution • gets hot	list principle applies for incorrect observations ignore just hydrogen produced ignore cloudiness / colour changes accept magnesium / magnesium sulfate / solid / it dissolves accept forms a liquid / solution allow exothermic ignore floats	2
3(b)(iii)	crystallisation **or** evaporation / heating / boiling / cooling	accept detailed answers such as: evaporate to half volume and then allow the solution to crystallise. ignore any references to filter	1
Total			**6**

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CHY2H

Question 4

question	answers	extra information	mark
4(a)	gives out heat / energy **or** energy / heat transferred to the surroundings	allow release / loses allow the products have less energy ignore temperature rises allow more energy given out in forming bonds than taken in to break bonds	1
4(b)(i)	speed up the reaction (owtte)	accept changes the rate accept lowers activation energy accept increases <u>successful</u> collisions accept allows reaction to take place at a lower temperature	1
4(b)(ii)	nitrogen (N_2) / oxygen (O_2) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging **or** (harmful) nitrogen monoxide / NO is not released into the air.	ignore releases nitrogen / oxygen unless qualified accept prevents / less acid rain ignore greenhouse gas / ozone layer	1
4(b)(iii)	2 and 2	accept correct multiples or fractions	1
4(b)(iv)	idea of catalyst not being used up	allow not changed by reaction ignore catalyst does not take part ignore catalyst not used in the reaction	1

Question 4 continues on the next page

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CHY2H

Question 4 contd

question	answers	extra information	mark
4(b)(v)	idea of different reactions (require different catalysts)	accept catalysts work for specific reactions allow different gases	1
4(c)	• smaller / very small / or any indication of very small / 1–100 nanometres / a few (hundred) atoms • big(ger) surface area • less (catalyst) needed / small amount of catalyst needed	ignore just small ignore size of the converter	1 1 1
Total			**9**

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CHY2H

Question 5

question	answers	extra information	mark
5	**three** from:	reference to ionic / metallic / intermolecular / (small) molecules = max **2**	3
	structure: (max 2)		
	• giant structure / macromolecule / all the atoms are joined together	allow (giant) lattice ignore large structure ignore diamond structure	
	• covalent (bonds)		
	• strong bonds / bonds difficult to break		
	• each silicon atom forms 4 bonds and / or each oxygen atom forms 2 bonds		
	explanation: (max 2)		
	• a lot of energy needed to break the bonds	if neither point given accept high temperature needed to break bonds for **1** mark	
	• high melting point		
	• does not burn **or** react with oxygen		
Total			**3**

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CHY2H

Question 6

question	answers	extra information	mark
6(a)(i)	less drying time **and/or** less soaking time	allow it is quicker / faster allow converse if they state water	1
6(a)(ii)	forces of attraction / bonds between molecules are weak (owtte) **or** intermolecular forces / bonds are weak (owtte)	do not accept intramolecular forces / covalent bonds are weak forces of attraction are weak (without specifying between molecules / intermolecular) gains **1** mark (accept easily broken / not much energy needed to break instead of weak) bonds are weak without specifying intermolecular would **not** gain a mark and would be ignored. made of small molecules / simple molecular gain **1** mark an answer such as, it is made of small molecules with weak forces of attraction, would gain **2** marks	2
6(b)(i)	exothermic reaction (owtte)	accept answers based on Le Chatelier eg when temperature is low the reaction moves to increase the temperature accept reverse argument	1

Question 6 continued on the next page

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Question 6 contd

question	answers	extra information	mark
6(b)(ii)	fewer product molecules / particles (than reactants molecules) (owtte)	accept three molecules / particles / volumes / moles on the left and one on the right (numbers given must be correct) accept answers based on Le Chatelier eg when pressure is high, reaction moves to the side with fewest molecules / smaller volume **or** when pressure is high, reaction moves to reduce the pressure do **not** accept reference to atoms do not accept more reactants than products unless qualified	1
6(b)(iii)	any **two** from: • molecules / particles / they move faster • collide more (often) / quicker • more of the collisions are successful **or** more have the activation energy (owtte) **or** more energetic collisions	 ignore move / vibrate more allow harder collisions allow collide with more force	2
6(c)(i)	16	correct answer with or without working accept correct rounding if the answer is incorrect then check the working. for **1** mark look for correct method in one line of the working. Moles of CO = 14/28 **or** 0.5 **or** Mass of CH_3OH = 0.5 × 32 **or** 28 → 32 **or** 14 → 32/2 **or** $\frac{32}{28} \times 14$	2

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Question 6 contd

question	answers	extra information	mark
6(c)(ii)	75	correct answer with or without working allow correct answer with ecf from (c)(i) for **2** marks if the answer is incorrect $\frac{12}{16}\times 100$ **or** $\frac{12}{\text{their (c)(i)}}\times 100$ gains **1** mark **OR if working from 18 g** 66.6 recurring or correctly rounded to a max of 67 = **2** marks incorrect rounding eg 66 = **1** mark **or** $\frac{12}{18}\times 100$ gains **1** mark	2
6(c)(iii)	reversible reaction **or** not all reactants converted to product (owtte) **or** other sensible reason such as: loss of product / reactant **or** impurities in reactants **or** side reactions / other products **or** temperature too high / pressure too low	 allow ‘it did not all react’ allow gas is lost ignore mass lost ignore some is lost	1
Total			**12**

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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	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2010

Additional Science
Unit Chemistry C2

CHY2H

H

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.

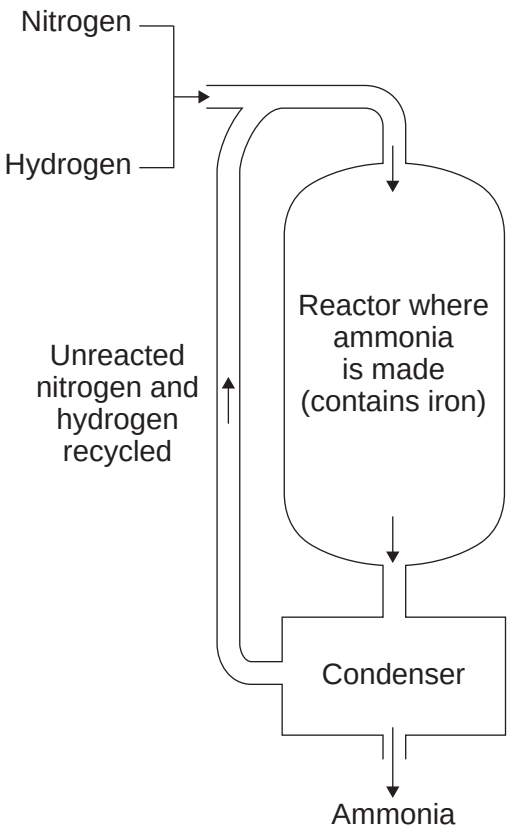
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

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



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

nitrogen + ... → .....

(1 mark)

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

.....

.....

(1 mark)

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

.....

.....

.....

.....

(2 marks)

Do not write outside the box

1 (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)

1 (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

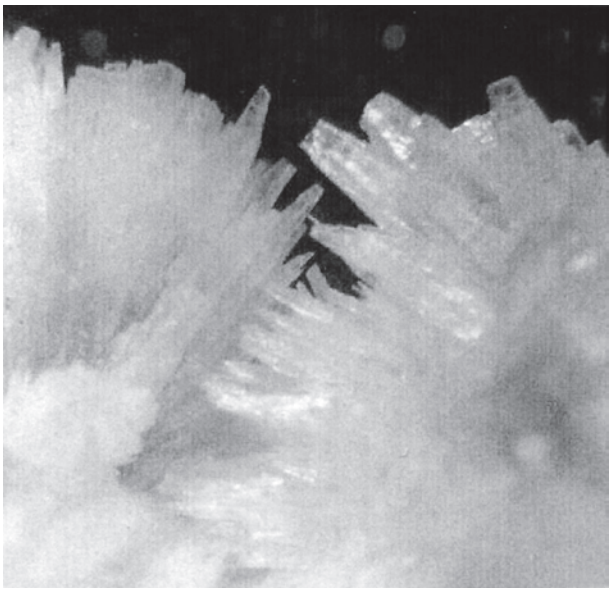
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Do not write outside the box

2 (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.

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

Do not write outside the box

2 (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

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

.....

.....

(1 mark)

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

Explain how you know.

Experiment ☐ because .....

.....

(1 mark)

2 (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)

2 (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

Turn over ▶

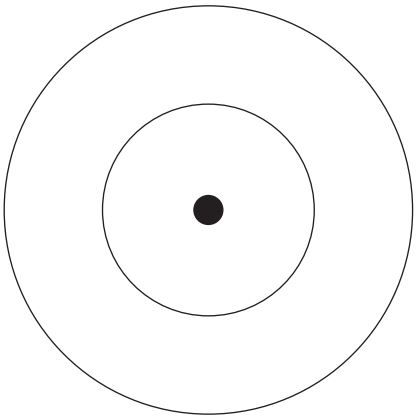
Do not write outside the box

3 Pure carbon can exist in two forms, diamond and graphite.

3 (a) Complete the diagram to show the electronic structure of a carbon atom.

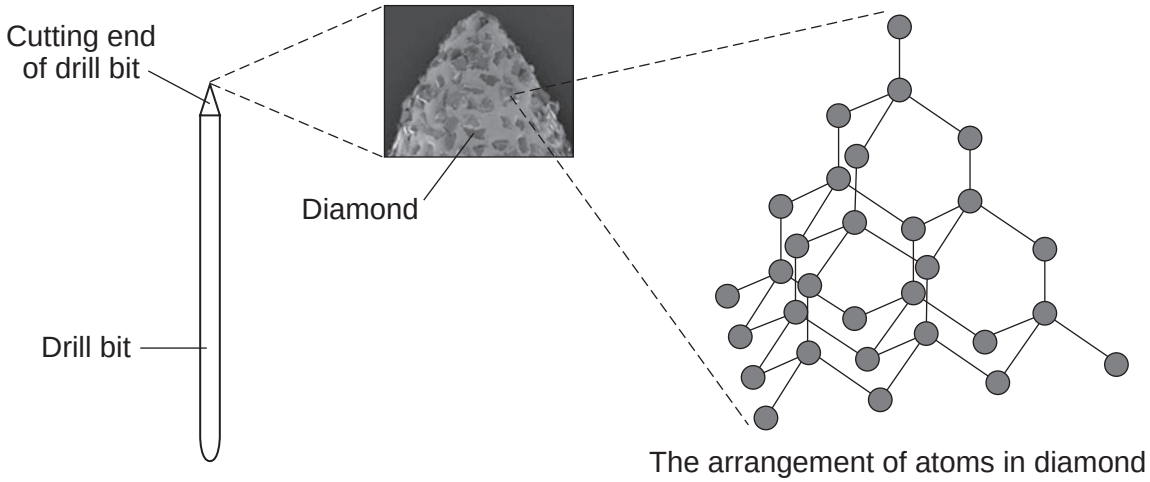
A carbon atom has 6 electrons.

Show the electrons as crosses (x).



(1 mark)

3 (b) 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

Do not write outside the box

3 (b) (i) What property of diamond makes it suitable for use on the cutting end of a drill bit?

.....

(1 mark)

3 (b) (ii) Explain, as fully as you can, why diamond has this property. Use your knowledge of the structure and bonding of diamond and the information shown opposite to help you to answer this question.

.....

.....

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(3 marks)

3 (c) Explain why graphite is a good conductor of electricity and why diamond does **not** conduct electricity.

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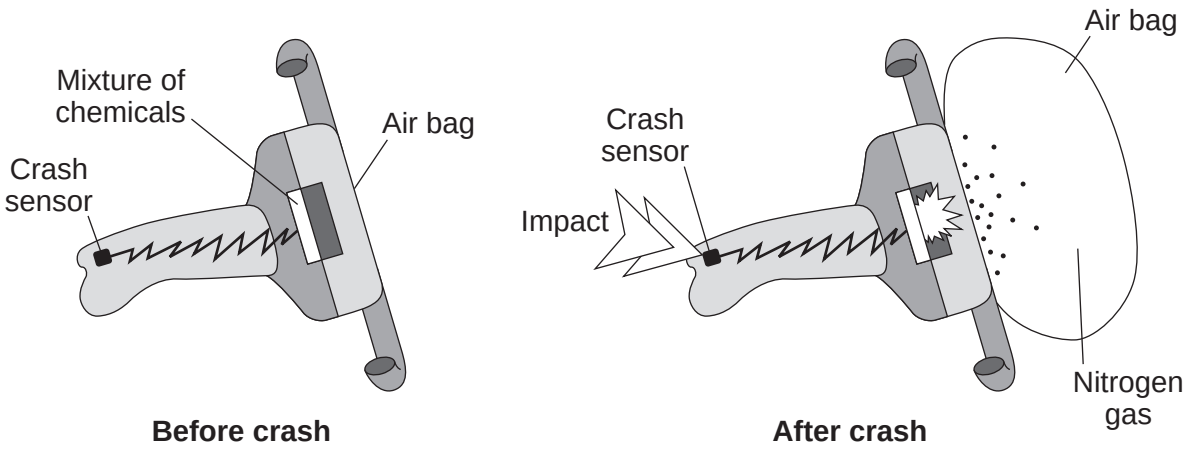
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(3 marks)

8

Do not write outside the box

4 Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



Before crash **After crash**

4 (a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

4 (a) (i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

.....

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Mass of nitrogen = ... g

(3 marks)

Do not write outside the box

4 (a) (ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

.....

Volume = ... litres

(1 mark)

4 (b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

4 (b) (i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$$10Na + ...KNO_3 \rightarrow .....Na_2O + K_2O + N_2$$

(1 mark)

4 (b) (ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

.....

.....

(1 mark)

6

Turn over for the next question

Do not write outside the box

5 This question is about some compounds of iodine.

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 precipitate.

$$Pb^{2+}(aq) + 2I^{-}(aq) \rightarrow PbI_2(s)$$

5 (a) (i) 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 name:

a soluble compound which contains lead ions .....

a soluble compound which contains iodide ions .....

(2 marks)

5 (a) (ii) Suggest a method of separating the lead iodide from the solution.

.....

(1 mark)

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

$$Mg + I_2 \rightarrow MgI_2$$

Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^{-}).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

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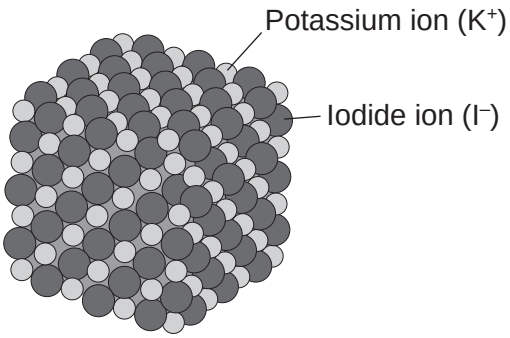
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(4 marks)

5 (c) The diagram shows the structure of potassium iodide.



Explain why a high temperature is needed to melt potassium iodide.

.....

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(2 marks)

9

Turn over for the next question

Do not write outside the box

6 The equation for a reaction to produce hydrogen is:

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

6 (a) Explain why changing the pressure does **not** affect the yield of hydrogen at equilibrium.

.....

.....

(1 mark)

6 (b) Suggest why the best yield of hydrogen at equilibrium is obtained at **low** temperatures.

.....

.....

(1 mark)

6 (c) The temperature used in industry needs to be high enough for the reaction to take place quickly. Explain, in terms of particles, why the rate of reaction increases when the temperature is increased.

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(3 marks)

6 (d) Scientists have developed catalysts which allow the reaction to take place quickly at lower temperatures. How could this be good for the manufacturer and for the environment?

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.....

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(2 marks)

7

END OF QUESTIONS

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Version: 17/08/2010

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H 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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CHY 2H

Question 1

question	answers	extra information	mark
1(a)(i)	(nitrogen) + hydrogen → ammonia	accept H_2 and NH_3 ignore incorrect symbols ignore balancing	1
1(a)(ii)	any **one** from: • catalyst • to speed up the reaction • lower activation energy	 ignore causes reaction ignore heat / reference to particles	1
1(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 1 continues on the next page

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CHY 2H

Question 1 continued

question	answers	extra information	mark
1(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
1(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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CHY 2H

Question 2

question	answers	extra information	mark
2(a)(i)	(different) properties	allow ideas of different property / behaviour / element	1
2(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
2(a)(iii)	other scientists obtained similar results / proved it **or** experiments were repeated		1

Question 2 continues on the next page

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CHY 2H

Question 2 continued

question	answers	extra information	mark
2(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
2(b)(ii)	2 **and** takes in heat / energy **or** 2 **and** temperature goes down (owtte)		1
2(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
2(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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CHY 2H

Question 3

question	answers	extra information	mark
3(a)	2,4 (drawn as crosses) on shells	accept dots / e / - etc.	1
3(b)(i)	hard	allow rigid / high melting point do **not** allow references to bonding ignore strong ignore unreactive ignore structure	1
3(b)(ii)	any **three** from • giant structure / lattice / macromolecular • covalent (bonds) • (covalent) bonds are strong • (each) carbon / atom forms four bonds **or** (each) carbon / atom bonded to four other atoms	max **2** if ionic / metallic / molecule / intermolecular bonds **or** incorrect number of bonds allow many bonds accept needs lots of energy to break bonds (owtte)	3

Question 3 continues on the next page

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CHY 2H

Question 3 continued

question	answers	extra information	mark
3(c)	any **three** from: graphite • has delocalised / free electrons **or** electrons that can move through / around the structure • each carbon is joined to three other carbon atoms **or** one electron from each atom is free / delocalised diamond • has no free / delocalised electrons **or** no electrons that move around the structure • all the electrons are used for bonding **or** each carbon joined to four other carbon atoms	max **2** if ionic / ions / metallic / molecule 'it' needs to be qualified do **not** accept the electrons move unless qualified (around structure etc) allow graphite has three bonds do **not** accept the electrons do not move allow diamond has 4 bonds	3
Total			**8**

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CHY 2H

Question 4

question	answers	extra information	mark
4(a)(i)	84 / 84.5 / 83.98	correct answer with or without working gains **3** marks (moles of NaN_3 =) 130/65 (1) moles of nitrogen = 3 (1) mass of nitrogen = 3 x 28 = 84 (1) **or** 2 x (23 + (3 x 14)) (1) 3 x (2 x14) (1) **or** $2NaN_3$ = 130 (1) $3N_2$ = 84 (1) if answer is incorrect then look for evidence of correct working. allow ecf from previous stage **1** mark lost for each mistake in the working if they do not have the correct answer.	3
4(a)(ii)	72 / 72.24 / 72.2 **or** 69 **or** 68.8	allow ecf from part (i) × 0.86 ignore working	1
4(b)(i)	2 **and** 5		1
4(b)(ii)	any **one** from: • corrosive / burns • alkaline / basic • attacks / destroys / damages living tissue / cells	 do **not** accept acidic allow irritant ignore reference to reactivity ignore reference to silicates ignore harmful / toxic	1
Total			**6**

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CHY 2H

Question 5

question	answers	extra information	mark
5(a)(i)	lead nitrate	accept $Pb(NO_3)_2$ do **not** accept nitride	1
	sodium iodide / potassium iodide	accept NaI / KI accept other correct soluble iodides do **not** accept sodium iodine / potassium iodine	1
5(a)(ii)	filter / filtration / filtering	accept decant / decanting etc. accept centrifugation ignore evaporation **or** heating if after filtration	1

Question 5 continues on the next page

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Question 5 continued

question	answers	extra information	mark
5(b)		metallic / sharing / covalent **or** molecule = max **3**	
	magnesium loses **2** electrons	all three underlined ideas must be present two underlined ideas = **1** mark eg magnesium loses electrons **or** magnesium gains 2 electrons **or** magnesium loses 2 ions nb magnesium **ion** loses 2 electrons = **1** mark 2 errors = **0** marks eg magnesium gains electrons	2
	iodine gains **1** / **an** electron	all four underlined ideas must be present three underlined ideas = **1** mark eg iodine gains electron(s) **or** iodine loses 1 / an electron **or** iodine gains 1 / an ion **or** iodide (ion) gains 1 / an electron 2 errors = **0** marks	2
5(c)	any **two** from: • forces *(*of attraction) / bonds are strong **or** lot of energy needed to break bonds • oppositely charged ions attract **or** electrostatic attraction between ions • giant structure **or** lattice	mention of molecules / intermolecular / covalent / atoms = max **1** allow many bonds ignore ionic bonding unqualified	2
Total			**9**

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CHY 2H

Question 6

question	answers	extra information	mark
6(a)	same number of (gaseous) molecules / moles / volume on both sides of the equation	allow particles for molecules do **not** accept atoms ignore amount	1
6(b)	(forward) reaction is exothermic	accept reverse answer	1
6(c)	any **three** from: • particles gain energy • particles move faster • particles collide more **or** more collisions • more of the collisions are successful **or** more of the particles have the activation energy **or** particles collide with more force / energy	 allow particles collide faster / quicker ignore move more / vibrate more	3

Question 6 continues on the next page

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CHY 2H

Question 6 continued

question	answers	extra information	mark
6(d)	any **two** from: • more product *(*obtained in shorter time) • less fuel needed **or** lower fuel costs • less pollution caused by burning fuels **or** less specified type of pollution caused by producing heat / burning fuels • using less fuel conserves resources	 accept better yield (of product) accept less energy / heat / electricity needed ignore cheaper unqualified allow correct specified pollutants caused by burning fossil fuels eg CO_2 **/** greenhouse gases **or** correct effect of burning fossil fuels eg global warming accept thermal / heat pollution accept sustainable accept fossil fuels are non-renewable	2
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	
TOTAL	



General Certificate of Secondary Education
Higher Tier
January 2010

Additional Science
Unit Chemistry C2

CHY2H

H

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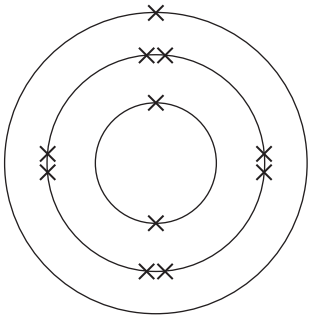
Answer **all** questions in the spaces provided.

1 Sodium chloride is a raw material.

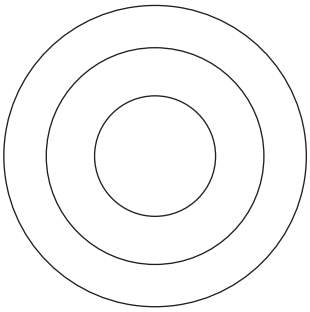
1 (a) The electronic structure of a sodium atom is shown below.

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

Sodium atom



Chlorine atom



(1 mark)

1 (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?

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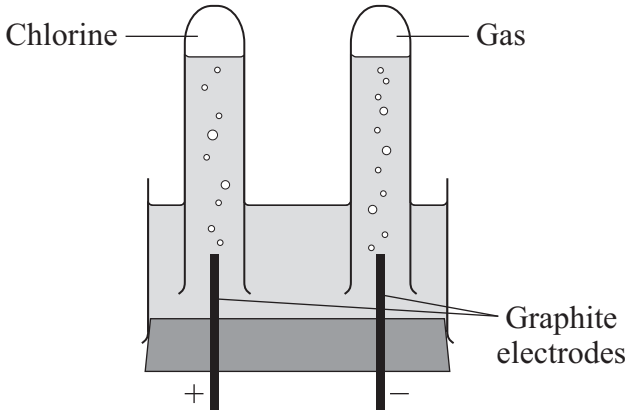
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(2 marks)

Areas outside the box will not be scanned for marking

1 (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^-).

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

.....

(1 mark)

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

.....

(1 mark)

Question 1 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

1 (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.'

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

1 (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

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Areas outside the box will not be scanned for marking

2 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.

2 (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)

2 (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)

Areas outside the box will not be scanned for marking

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

Suggest how this was done.

.....

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(1 mark)

2 (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.

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(4 marks)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

3 (a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

	Hydrogen-1	**Hydrogen-2**
Atomic number	1	1
Mass number	1	2

An atom of hydrogen-1 is represented as: $^{1}_{1}\mathbf{H}$

Show how an atom of hydrogen-2 is represented.

(1 mark)

3 (b) (i) Calculate the relative formula mass (M_r) of water, H_2O

Relative atomic masses: H = 1; O = 16.

.....

.....

Relative formula mass (M_r) = ...

(1 mark)

3 (b) (ii) Simple molecules like water have low boiling points.

Explain why, in terms of molecules.

.....

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(2 marks)

Areas outside the box will not be scanned for marking

3 (c) Molecules of heavy water contain two atoms of hydrogen-2 instead of two atoms of hydrogen-1.

Explain why a molecule of heavy water has more mass than a normal water molecule. You should refer to the particles in the nucleus of the two different hydrogen atoms in your answer.

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(2 marks)

6

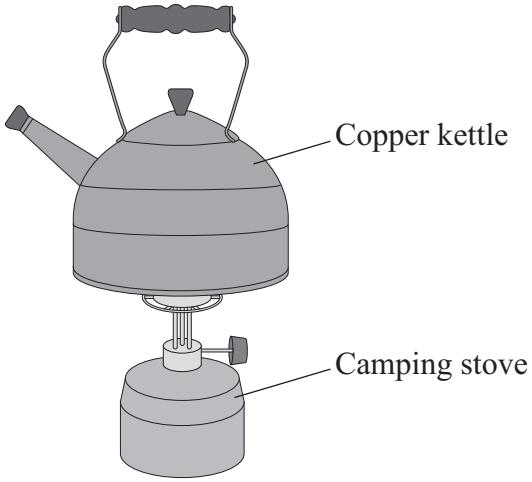
Turn over for the next question

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4 The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

- it has a high melting point
- it is a very good conductor of heat.



4 (a) Explain why copper, like many other metals, has a high melting point.
You should describe the structure and bonding of a metal in your answer.

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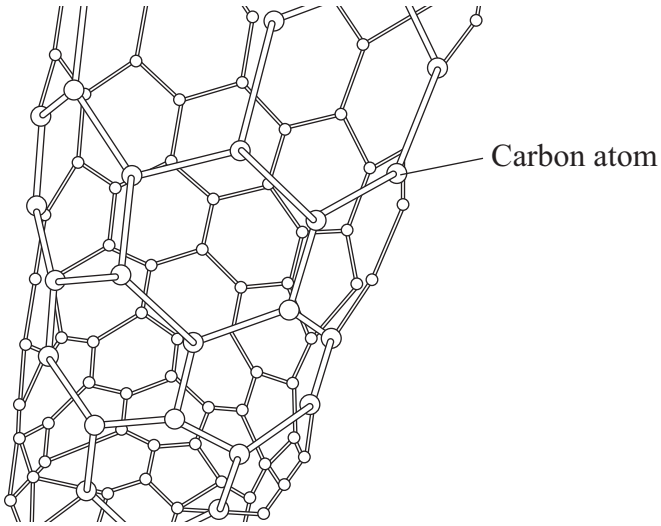
(4 marks)

Areas outside the box will not be scanned for marking

4 (b) An aeroplane contains many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by lighter carbon nanotubes.

The diagram shows the structure of a carbon nanotube.



4 (b) (i) What does the term 'nano' tell you about the carbon nanotubes?

.....

.....

(1 mark)

4 (b) (ii) Like graphite, each carbon atom is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

.....

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(2 marks)

7

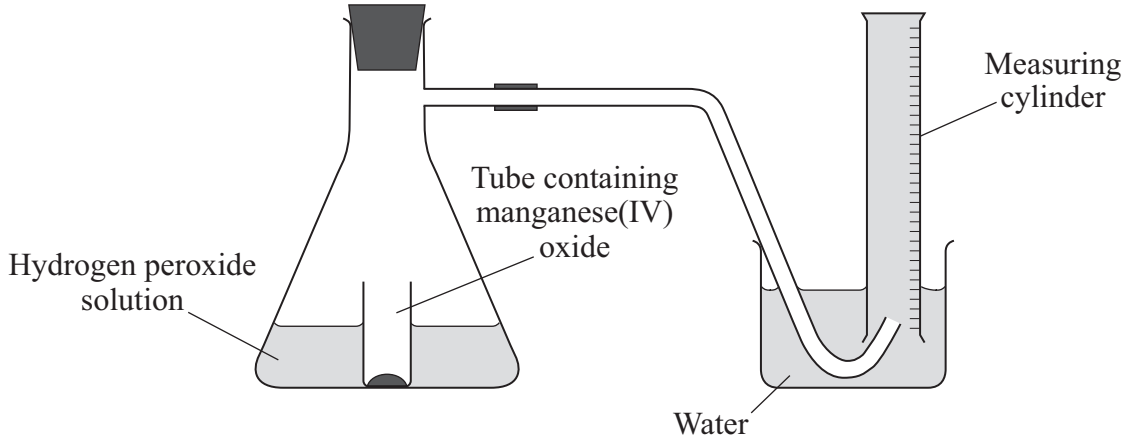
Turn over ▶

Areas outside the box will not be scanned for marking

5 A student investigated the effect of temperature on the decomposition of hydrogen peroxide. Hydrogen peroxide decomposes to oxygen and water when a manganese(IV) oxide catalyst is added.

The student measured the time taken to collect 5 cm^3 of oxygen gas.

The apparatus shown below was used for the investigation. The reaction was started by shaking the flask so that the manganese(IV) oxide and hydrogen peroxide were mixed.



The student did the investigation at two different temperatures. All the other variables were kept constant.

The student's results are shown in the table.

Temperature of the hydrogen peroxide solution in °C	**Volume of oxygen collected in cm^3**	**Time taken to collect the oxygen in seconds**	**Rate of reaction in cm^3 per second**
20	5	40	0.125
25	5	25	

5 (a) (i) Calculate the rate of reaction at 25 °C.

.....

Rate of reaction = ... cm^3 per second

(2 marks)

5 (a) (ii) The teacher said that the student should repeat the investigation to get more results.

Suggest why.

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

5 (b) The student concluded that:

'the rate of reaction increases when the temperature is increased'.

Explain, in terms of particles, why the rate of reaction increases.

.....

.....

.....

.....

.....

(2 marks)

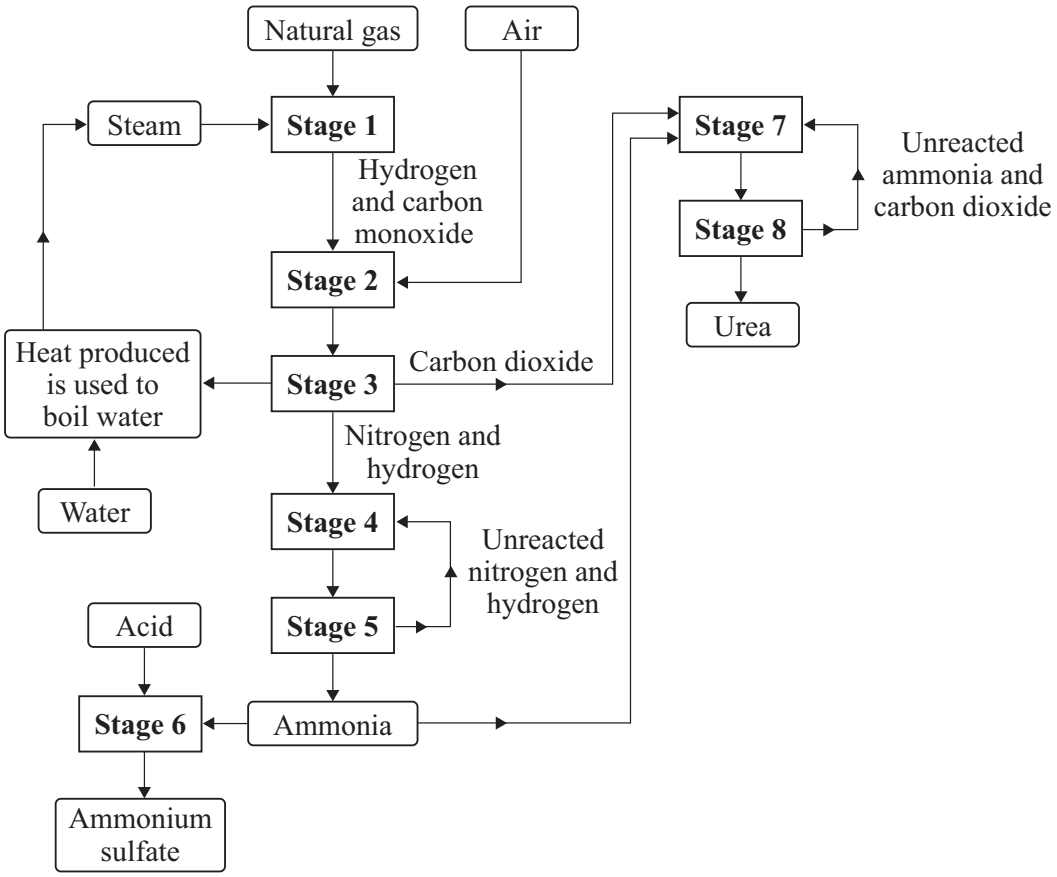
5

Turn over for the next question

Areas outside the box will not be scanned for marking

6 Ammonium sulfate and urea are made from ammonia.
These compounds are used by farmers.

The flow diagram shows the stages to make ammonium sulfate and urea.



6 (a) Give **two** examples from the flow diagram of efficient use of energy or materials.

.....

.....

.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

6 (b) Why do farmers use ammonium compounds?

.....

.....

(1 mark)

6 (c) The equation for a reaction that takes place in **Stage 1** is given below.

Balance this equation by putting the correct number on the dotted line.

$$CH_4 + H_2O \rightarrow CO + \ldots\ldots H_2$$

(1 mark)

6 (d) The equation for the reaction in **Stage 4** is shown below.

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

The forward reaction is exothermic.

6 (d) (i) Explain why, at equilibrium, the yield of ammonia for this reaction is greater at **low** temperatures.

.....

.....

(1 mark)

6 (d) (ii) Explain why a high temperature, 450 °C, is used in **Stage 4**.

.....

.....

(1 mark)

6 (e) Name the acid used in **Stage 6** to make ammonium sulfate.

..... acid

(1 mark)

Question 6 continues on the next page

Areas outside the box will not be scanned for marking

6 (f) **Stage 7** can be represented by this equation.

$$\underset{\text{ammonia}}{2NH_3} + CO_2 \rightarrow \underset{\text{urea}}{NH_2CONH_2} + H_2O$$

The table gives the relative formula masses (M_r) of the reactants and the products for this reaction.

Formula of reactant or product	**Relative formula masses (M_r)**
NH_3	17
CO_2	44
NH_2CONH_2	60
H_2O	18

Use information from the table to help you answer (f)(i) and (f)(ii).

6 (f) (i) One factory produces 6000 g of urea each second. Calculate the mass of ammonia needed to make 6000 g of urea.

.....

.....

.....

.....

Mass of ammonia needed = ... g

(3 marks)

6 (f) (ii) Percentage atom economy can be calculated using:

$$\text{Percentage atom economy} = \frac{M_r \text{ of useful product}}{\text{total } M_r \text{ of all reactants added together}} \times 100\%$$

Calculate the percentage atom economy for the reaction in **Stage 7**

.....

.....

.....

Percentage atom economy = ... %

(2 marks)

12

END OF QUESTIONS

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Version : 09/03/2010

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H 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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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.

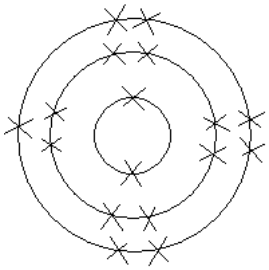
3.7 Brackets

(…..) 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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CHY2H

Question 1

question	answers	extra information	mark
1(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
1(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
1(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are <u>attracted</u> or it is oppositely charged ignore opposite forces attract	1
1(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 1 continues on next page

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CHY2H

Question 1 continued

question	answers	extra information	mark
1(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
1(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
1(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 2

question	answers	extra information	mark
2(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
2(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
2(c)	evaporation / crystallisation	accept heating / boiling accept 'leave for a few days' owtte allow cool do **not** allow freeze ignore filtration	1

Question 2 continues on next page

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CHY2H

Question 2 continued

question	answers	extra information	mark
2(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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Question 3

question	answers	extra information	mark
3(a)	$^{2}_{1}H$	2 and 1 must be on the left 2 must be above half-way on the H and the 1 below half-way accept diagram with 2 <u>different</u> particles in centre and 1 particle on circle	1
3(b)(i)	18	ignore working ignore units	1
3(b)(ii)	forces (of attraction) between molecules **or** bonding between molecules **or** intermolecular forces /intermolecular bonds		1
	are weak **or** not much energy needed to break them **or** easily overcome	must be linked to first mark if no other mark awarded allow <u>small</u> molecules / small M_r for **1** mark allow forces / bonds are weak for **1** mark do **not** allow covalent bonding is weak	1

Question 3 continues on next page

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Question 3 contd

3(c)		any reference to <u>more</u> protons = **0** marks	
	H-2 atoms have 1 proton and 1 neutron	allow H-2 has more neutrons / particles for **1** mark	1
	H-1 atoms have one proton **or** H-2 atom has one neutron (1) H-1 atom has no neutrons (1)	allow H-2 has two particles and H-1 has one particle for **1** mark allow H-2 atom has one more neutron for **2** marks **NB** heavy water (molecule) has 2 <u>more</u> neutrons = **2** marks heavy water (molecule) has more neutrons / particles = **1** mark if no other mark awarded then heavy water molecule has M_r of 20 = **1** mark ignore reference to electrons	1
Total			**6**

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Question 4

question	answers	extra information	mark
4(a)	any **four** from:	max **3** marks if any reference made to covalent / ionic bonding / molecules **or** intermolecular forces **or** graphite / diamond **or** forces of attraction between electrons and then ignore throughout	4
	• giant structure / lattice	ignore layers	
	• positive ions		
	• sea of electrons **or** delocalised / free electrons	ignore electrons can move	
	• awareness of outer shell / highest energy level electrons are involved		
	• (electrostatic) attractions / bonds between electrons and positive ions		
	• bonds / attractions (between atoms/ ions) are strong	allow hard to break for strong ignore forces unqualified	
	• a lot of energy / heat is needed to break these bonds / attractions	ignore high temperature	

Question 4 continues on next page

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Question 4 continued

question	answers	extra information	mark
4(b)(i)	that they are very small **or** 1–100 nanometres **or** a few (hundred) atoms	accept tiny / really small / a lot smaller / any indication of very small eg microscopic, smaller than the eye can see ignore incorrect numerical values if very small is given	1
4(b)(ii)	any **2** from: • one (non-bonded) electron from each atom • delocalised / free electrons • electron carry / form / pass current / charge	 allow sea of electrons ignore electrons can move ignore carry electricity	2
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i)	0.2	correct answer gains **2** marks with or without working accept answer in table if answer incorrect 5/25 gains **1** mark	2
5(a)(ii)	any **one** from: • wider range of temperatures (owtte) • (repeat at the same temperature) to improve accuracy / reliability • reveal anomalous results (owtte) • so you can get an average / better average	 allow to make it reliable / accurate allow to eliminate random / human errors / to check results owtte ignore to make it a fair test / to get better results ignore precision and validity	1
5(b)	any **two** from: • particles gain energy / have more energy • particles move faster • particles collide more • more of the particles have the activation energy **or** more of the collisions are successful (owtte) **or** particles <u>collide</u> with more force / harder / more energy	allow atoms / molecules / they instead of particles throughout ignore increases particles activation energy ignore move more / vibrate more ignore increases / decreases activation energy allow more successful collisions alone for **1** mark	2
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)	any **two** from: • heat water / make steam / boil water **or** heat / steam used in stage 1 • carbon dioxide from stage 3 used in stage 7 / to make urea • nitrogen and / or hydrogen recycled (owtte) • ammonia and / or carbon dioxide <u>recycled</u> (owtte)	allow reused instead of recycled in correct context allow unreacted material / gas recycled from stage 5 (to 4) allow unreacted material / gas recycled from stage 8 (to 7) NB if neither of the last two points are awarded unreacted material recycled = **1** mark	2
6(b)	any **one** from: • fertiliser / fertilise / fertile • provide nitrogen • any idea of faster / better / helps growth of crop • greater yield of crop • helps proteins / amino acids to form in plants owtte	ignore cost ignore neutralisation / minerals / to treat plants / photosynthesis allow give plants nutrients allow provides nitrate	1
6(c)	3	allow correct multiples eg $2CH_4 + 2H_2O \rightarrow 2CO + 6H_2$	1
6(d)(i)	(forward reaction is) exothermic / gives out heat	accept Le Chatelier based answers accept reverse argument eg because at high temperature the ammonia would decompose	1

Question 6 continues on the next page...

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CHY2H

Question 6 continued

question	answers	extra information	mark
6(d)(ii)	reaction is too slow / takes too long **or** to make the reaction fast(er)	allow answers that imply increased rate eg more collisions / particles have more energy allow catalyst works better ignore optimum condition / compromise type answers ignore yield	1
6(e)	sulfuric / H_2SO_4	accept sulphuric	1
6(f)(i)	3400	correct answer gains all **3** marks with or without working if answer incorrect: 1700 with or without working or 6000 × (34/60) gains **2** marks **or** 6800 gains **2** marks with or without working **or** moles of urea = 6000/60 = 100 gains **1** mark moles of ammonia needed = 200 gains **1** mark **or** 6000 × (17/60) gains **1** mark **or** (2×17) → 60 gains **1** mark **or** 34 → 60 gains **1** mark	3

Question 6 continueson the next page

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CHY2H

Question 6 continued

question	answers	extra information	mark
6(f)(ii)	76.9	correct answer gains **2** marks with or without working. allow 77 or 76.923… allow 76 **or** 0.77 **or** 0.76923 for **1** mark if answer incorrect allow **1** mark for **either** identifying the mass of the useful product **or** the total M_r of reactants – this can be awarded from the numbers in the calculation: M_r of useful product = 60 M_r of reactants = 78 **or** (2×17)+44 **or** 60 +18 60/78 × 100 gains **1** mark	2
Total			**12**

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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

CHY2H

H

CHEMISTRY
Unit Chemistry C2

Higher 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

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

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.

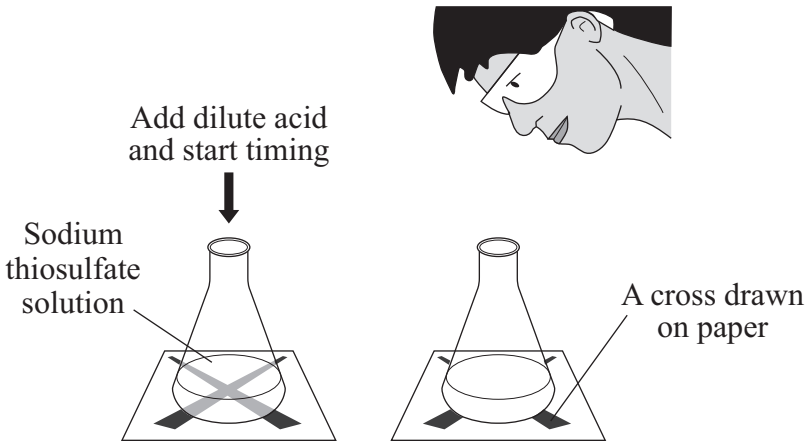
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Areas outside the box will not be scanned for marking

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

1 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.

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

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

1 .....

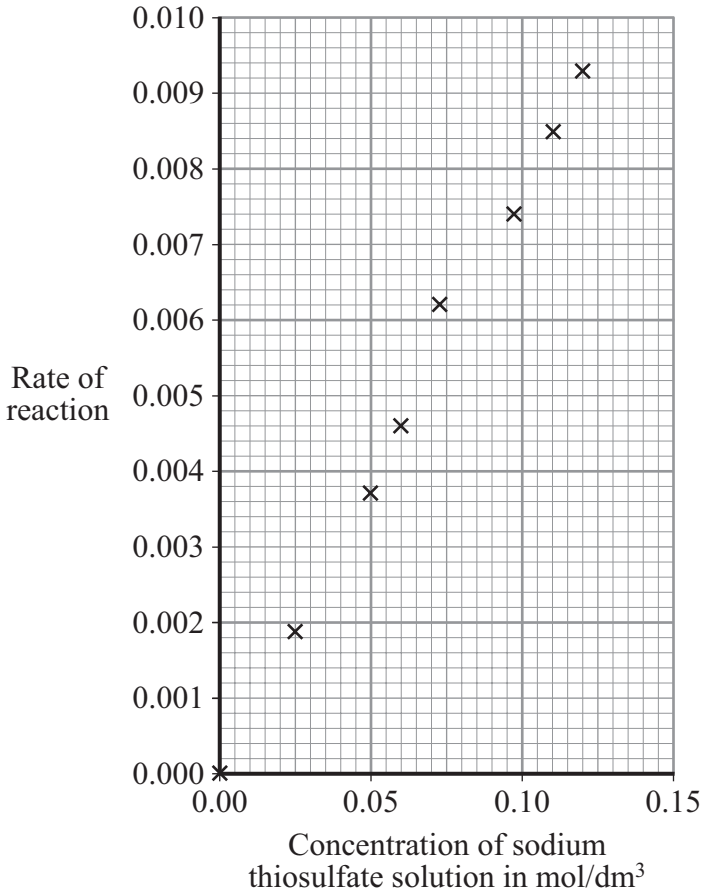
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2 .....

.....

(2 marks)

Areas outside the box will not be scanned for marking



1 (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)

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

.....

.....

.....

.....

(2 marks)

6

Areas outside the box will not be scanned for marking

2 This question is about methods of treating water.

2 (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.

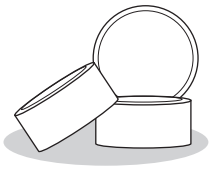
$$Cl_2(g) + H_2O(l) \rightleftharpoons 2H^+(aq) + OCl^-(aq) + Cl^-(aq)$$

An acidic solution is produced when chlorine reacts with water.

Which ion, shown in the equation, makes the solution acidic? .....

(1 mark)

2 (b) Calcium hypochlorite tablets are added to water in some swimming pools to kill microorganisms.



The formula of calcium hypochlorite is $CaCl_2O_2$

2 (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)

2 (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

2 (b) (iii) Calculate the mass of chlorine in a 20 g tablet of calcium hypochlorite.

.....

.....

Mass of chlorine = ... g

(1 mark)

2 (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.

$$Cr^{3+}(aq) + 3OH^{-}(aq) \rightarrow Cr(OH)_3(s)$$

2 (c) (i) What type of substance would be added to the water to provide the OH^- ions?

.....

.....

(1 mark)

2 (c) (ii) A *precipitate* is formed in this reaction.

What is a *precipitate*?

.....

.....

(1 mark)

2 (c) (iii) What method could be used to separate the precipitate from the solution?

.....

.....

(1 mark)

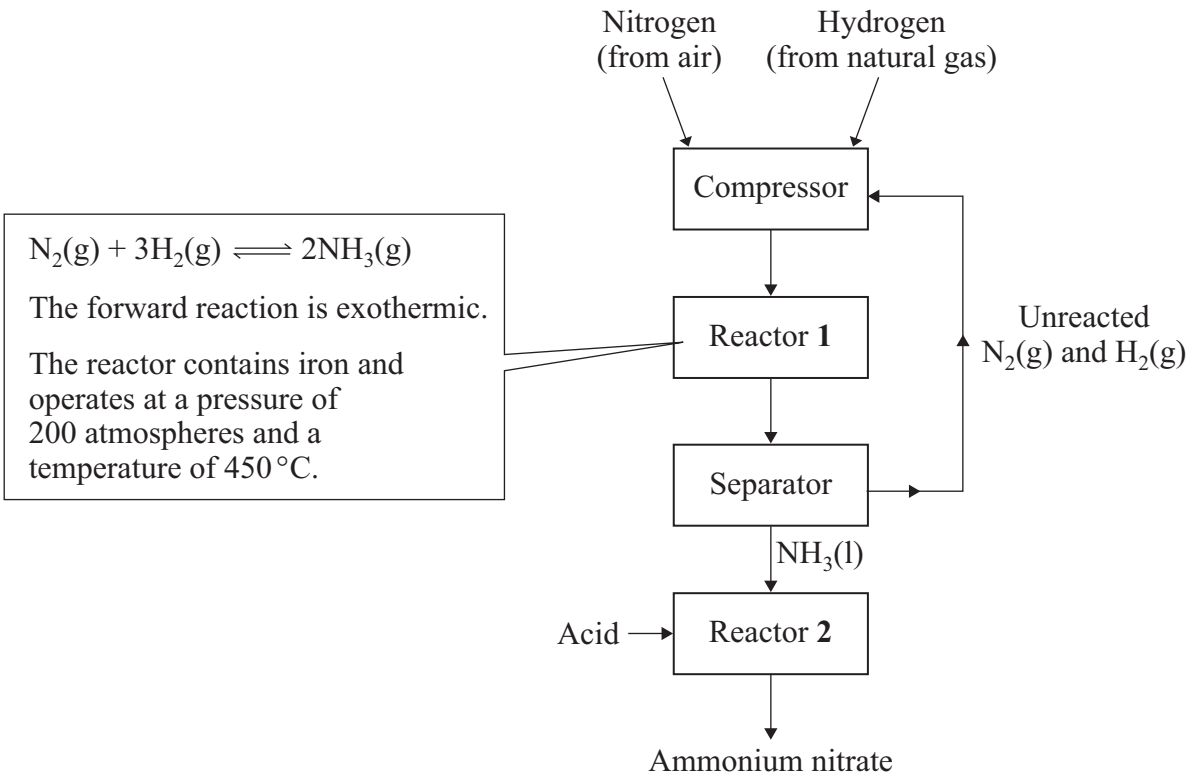
9

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 question.



3 (a) What is the purpose of the iron in reactor **1**?

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

3 (b) Explain why the best yield of ammonia at equilibrium is obtained:

3 (b) (i) at low temperature

.....

.....

(1 mark)

3 (b) (ii) at high pressure.

.....

.....

(1 mark)

3 (c) The temperature used in reactor **1** is 450 °C.

Explain why a much lower temperature is **not** used.

.....

.....

(1 mark)

3 (d) A mixture of ammonia, nitrogen and hydrogen leaves reactor **1**.

In the separator, what is done to the mixture to separate the ammonia from the other gases?

.....

.....

(1 mark)

3 (e) Name the acid that reacts with ammonia in reactor **2** to make ammonium nitrate.

.....

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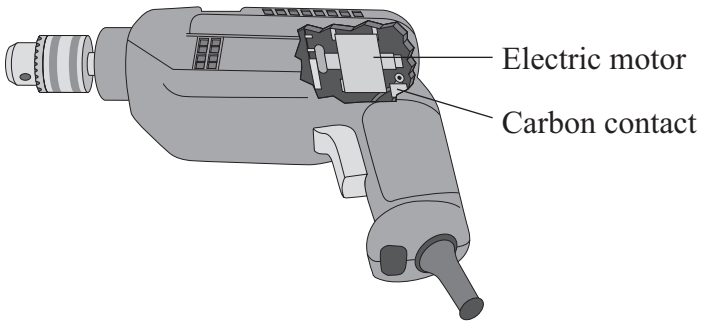
(1 mark)

6

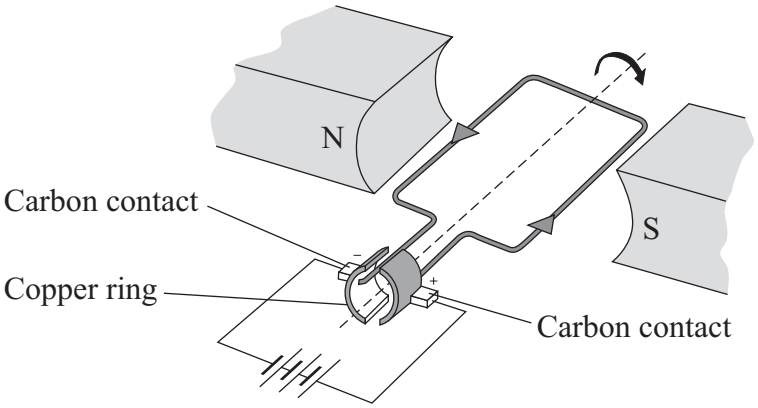
Turn over ▶

Areas outside the box will not be scanned for marking

4 This drill contains an electric motor.



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



Areas outside the box will not be scanned for marking

The carbon contacts are made of graphite. Springs push the contacts against the copper ring. The 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.

Graphite has properties which are ideal for making the contacts in an electric motor.

Explain, in terms of structure and bonding, why graphite has these properties.

.....

.....

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.....

(5 marks)

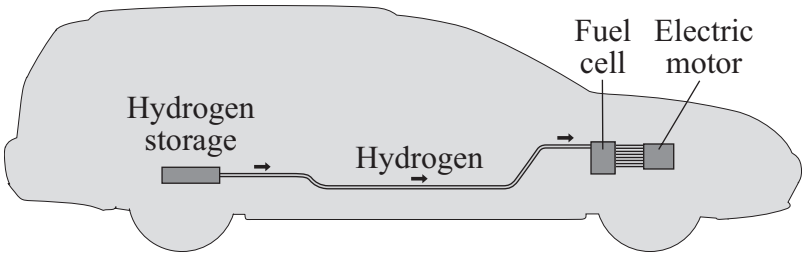
5

Turn over for the next question

Areas outside the box will not be scanned for marking

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

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. It can be made by the electrolysis of potassium hydroxide solution.

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. A chemical reaction takes place between the hydrogen and the lithium nitride. The hydrogen is held in the resulting compounds by chemical bonds.

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. These particles absorb hydrogen in the same way as normal sized lithium nitride particles. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

It is hoped that 'nanosized' particles of lithium nitride may provide a safe method of storing hydrogen in the future.

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Areas outside the box will not be scanned for marking

5 (a) Hydrogen is produced at the negative electrode during the electrolysis of potassium hydroxide solution.

5 (a) (i) Why are hydrogen ions attracted to the negative electrode?

.....

.....

.....

(1 mark)

5 (a) (ii) Potassium ions are also attracted to the negative electrode.

Explain why hydrogen gas is formed but not potassium.

.....

.....

.....

(1 mark)

5 (b) Lithium nitride is made by reacting lithium with nitrogen.

Balance the equation for this reaction.

..... Li + N_2 → ..... Li_3N

(1 mark)

Question 5 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

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

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

What feature of this reaction allows the hydrogen to be released?

.....

.....

(1 mark)

5 (c) (ii) Hydrogen stored in a fuel tank filled with lithium nitride would be safer in an accident than a cylinder full of hydrogen.

Suggest and explain why.

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(2 marks)

5 (d) (i) State how 'nanosized' particles will be different from normal sized particles of lithium nitride.

.....

.....

(1 mark)

5 (d) (ii) Suggest why the 'nanosized' particles of lithium nitride absorb and release the hydrogen more quickly than normal sized particles.

.....

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

5 (e) Lithium nitride is an ionic compound which contains lithium ions (Li^+) and nitride ions (N^{3-}).

5 (e) (i) The formation of a lithium ion from a lithium atom is an oxidation reaction.

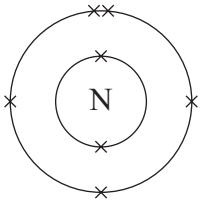
Explain why.

.....

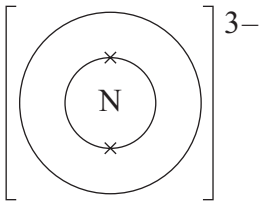
.....

(1 mark)

5 (e) (ii) The diagram shows the electronic structure of a nitrogen atom.



Complete the diagram below to show the electronic structure of a nitride ion (N^{3-}).



(1 mark)

10

Turn over for the next question

Areas outside the box will not be scanned for marking

6 Perfumes contain a mixture of chemicals.



The main ingredients of perfumes are a solvent and a mixture of fragrances.

6 (a) A sample of the solvent used in one perfume contained 0.60 g of carbon, 0.15 g of hydrogen and 0.40 g of oxygen.

Relative atomic masses: H = l; C = 12; O = 16.

Calculate the empirical (simplest) formula of the solvent.

You must show all of your working to gain full marks for this question.

.....

.....

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(4 marks)

Areas outside the box will not be scanned for marking

6 (b) Solvent molecules evaporate easily.

Explain why substances made of simple molecules evaporate easily.

.....

.....

.....

.....

.....

(2 marks)

6 (c) Most companies claim that their perfumes have been tested on skin. A study was made of the tests they used. The study found that each company used different tests. The perfumes were tested in the companies' own laboratories and **not** by independent scientists.

Some companies did not give any information about the tests that they had used.

6 (c) (i) Suggest why companies test their perfumes on skin.

.....

.....

.....

(1 mark)

6 (c) (ii) Did the study show that the tests made by the different companies were valid and reliable?

Explain your answer.

.....

.....

.....

.....

.....

(2 marks)

9

END OF QUESTIONS

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There are no questions printed on this page

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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

CHY2H 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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CHY2H

Question 1

question	answers	extra information	mark
1(a)(i)	a continuous straight line missing anomalous point	allow a line which does not start at zero / origin	1
1(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
1(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 1 continues on the next page…

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CHY2H

Question 1 Continued

question	answers	extra information	mark
1(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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CHY2H

Question 2

question	answers	extra information	mark
2(a)	hydrogen / H^+ /$2H^+$ / H_3O^+	allow H / 2H do **not** accept H_2 apply list principle	1
2(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
2(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
2(b)(iii)	9.9 to 10g	allow ecf from (b)(i) or (b)(ii)	1

Question 2 continues on the next page…

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CHY2H

Question 2 Continued

question	answers	extra information	mark
2(c)(i)	an alkali	apply list principle accept named alkali accept hydroxide accept soluble base ignore base	1
2(c)(ii)	a solid / insoluble substance (owtte)		1
2(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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CHY2H

Question 3

question	answers	extra information	mark
3(a)	to speed up the reaction **or** it is a catalyst	allow higher level answers such as to reduce the activation energy ignore cost or yield	1
3(b)(i)	reaction is exothermic	accept reverse reaction is endothermic **or** high temperature causes decomposition of ammonia ignore reference to rate	1
3(b)(ii)	more (gaseous) reactant molecules than (gaseous) product molecules	accept 4 volumes / moles of reactant and 2 volumes / moles of product accept lower volume of products **or** volume lower on right hand side accept 'favours the reaction which produces fewer molecules' ignore incorrect number of moles ignore reference to' amount' of product / reactant ignore reference to rate	1
3(c)	(rate is) too slow / slower owtte	allow catalyst would not work accept at higher temperature the rate is quicker accept at lower temperatures particles do not collide as often **or** fewer particles have the activation energy **or** particles do not have the activation energy ignore reaction would not work ignore optimum / compromise type answers	1

Question 3 continues on the next page…

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CHY2H

Question 3 Continued

question	answers	extra information	mark
3(d)	cooled	allow ammonia / it is turned into a liquid **or** is condensed ignore references to boiling point	1
3(e)	nitric (acid)	allow HNO_3 ignore hydrogen nitrate	1
Total			**6**

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CHY2H

Question 4

question	answers	extra information	mark
4	**five** ideas from the following for one mark each • each carbon / atom joined / bonded to three other carbon / atoms **or** each carbon forms 3 bonds • in layers • only weak forces (of attraction) / bonds between layers • layers / atoms can slide over each other • one electron on each carbon is not used for bonding • electrons delocalised **or** electrons free • electrons carry the charge / current • giant structure / lattice • covalent (bonds) • strong bonds **or** a lot of energy needed to break bonds	reference to ionic bonding = **max 4** diagrams could be used: • to show layered structure • to show that each carbon is bonded to three other carbon atoms • to show giant structure (at least 3 rings required) allow weak electrostatic / intermolecular forces /bonds between layers allow 'sea' of electrons	5
Total			**5**

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CHY2F

Question 5

question	answers	extra information	mark
5(a)(i)	any **one** from: • they are positive / cations • they are H^+ • opposite charges attract	ignore atom	1
5(a)(ii)	potassium is more reactive (or reverse)	assume 'it' refers to hydrogen allow potassium reacts with water allow potassium is very reactive **or** most reactive metal / element allow hydrogen gains electrons more easily / is reduced more easily accept potassium is higher up the reactivity series	1
5(b)	6 **and** 2	accept correct multiples and fractions	1
5(c)(i)	the reaction / it is reversible **or** a description of a reversible reaction	allow 'it is an equilibrium' allow reversible symbol drawn correctly allow 'the reverse / back reaction'	1

Question 5 continues on the next page…

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CHY2H

Question 5 Continued

question	answers	extra information	mark
5(c)(ii)	**lithium nitride** assume that 'it' or if they do not specify means lithium nitride assume lithium / lithium nitrate refers to lithium nitride • hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride plus **one** of: • does not explode / cause a fire • is not free / less hydrogen • is not under pressure • does not leak • is only released slowly • compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction	accept converse for hydrogen as below assume that gas / hydrogen means gas in the cylinder • hydrogen (in cylinder) / gas is not bonded / held / absorbed / in a compound / reacted with lithium nitride plus **one** of: • can explode / cause a fire • is free • is under pressure • can leak • releases quickly	1 1
5(d)(i)	smaller **or** correct indication of size **or** higher surface area	allow very / really small **or** tiny accept few (100) atoms in size allow 1 to 100 nanometres or 10^{-9} metres allow absorption and / or release of hydrogen more quickly allow have different properties allow 'more particles in each volume / area' do not allow reacts more quickly	1

Question 5 continues on the next page…

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CHY2H

Question 5 Continued

question	answers	extra information	mark
5(d)(ii)	greater surface area		1
5(e)(i)	loss of an electron **or** loses electrons	do not accept any ref. to oxygen	1
5(e)(ii)	full outer shell of 8 electrons on circle	need not be paired can be ×, dot or e do **not** accept if extra electrons added to inner shell	1
Total			**10**

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CHY2H

Question 6

question	answers	extra information	mark
6(a)	C H O		
	0.60 0.15 0.40 12 1 16	**1** mark for dividing the correct amount or multiples of correct amount by A_r	1
	= 0.05 = 0.15 = 0.025	**1** mark for proportions	1
	2 6 1	**1** mark for whole number ratio – accept any multiple	1
	C_2H_6O	**1** mark for correctly written simplest formula correct formula without working gets only **2** marks correct formula gains full marks provided steps 1 and 2 are correct. ecf can be allowed from step 2 to 3 **or** step 3 to 4 formula can be in any order eg OH_6C_2	1
6(b)	intermolecular forces / bonds		1
	are weak	(covalent) bonds are weak = 0	1
	or		
	forces between molecules **or** bonds between molecules (1)	(attractive) forces are weak = 1	
	are weak (1)	if no marks awarded, allow low boiling point **or** small M_r for **1** mark	

Question 6 continues on the next page…

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CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(i)	to check the safety of the perfume (owtte)	accept references to possible harmful / dangerous effects of perfume **or** possible reactions on skin eg to show it does not damage skin / cause cancer etc. allow to see what it smells like <u>on the skin</u> allow so the company do not have to test on animals	1

Question 6 continues on the next page…

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CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(ii)	any **two** from: idea from text **linked with** an explanation • the company claim to have tested the product: but we cannot be certain they have **or** how thorough they are **or** how accurately reported • companies did not disclose how they did their tests: so they could not be checked **or** so they could not be shown to be reliable / valid **or** so they could not be repeated • companies may not have repeated their tests: so they may not be reliable • companies do their own tests: so they may be biased **or** so they may not be truthful about their results **or** so they may not be reliable • the companies are using different tests: so the results cannot be compared **or** so results will be different **or** so results will not be fair / valid / reliable • companies would not give false information because of damage to reputation **or** it might lead to litigation	or converse eg companies should disclose how they did their tests so that results can be checked etc. or converse eg independent tests should be done so as to ensure there is no bias etc. or converse eg companies should do the same tests so that the results will be fair etc.	2
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

CHY2H

H

CHEMISTRY
Unit Chemistry C2

Higher 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		4	
2		5	
3		6	
		7	
		8	
		9	
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 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.



1 (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)*

1 (b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

.....

(1 mark)

1 (c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron? Remember to give the unit.

.....

(1 mark)

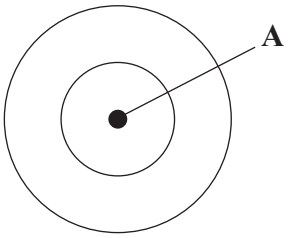
4

Areas outside the box will not be scanned for marking

2 This question is about oxygen atoms. The periodic table on the Data Sheet may help you to answer this question.

2 (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)

2 (a) (ii) Name the part of the oxygen atom that is labelled **A** on the diagram.

.....

(1 mark)

2 (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

3 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.

3 (a) How did Wöhler prove that a life force is **not** needed to make organic compounds?

.....

.....

(1 mark)

3 (b) Suggest why in 1828 most scientists continued to believe that a life force was needed to produce an organic compound.

.....

.....

(1 mark)

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3 (c) Suggest why in 1845 most scientists stopped believing that a life force was needed to make an organic compound.

.....

.....

(1 mark)

3 (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.

3 (d) (i) Give the name of this acid. .....

(1 mark)

3 (d) (ii) State how solid lead nitrate can be obtained from lead nitrate solution.

.....

.....

(1 mark)

3 (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)

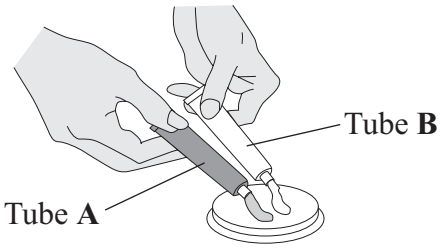
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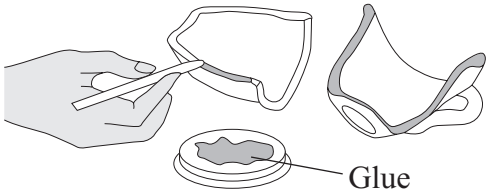
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4 The following steps show how to use a type of glue.

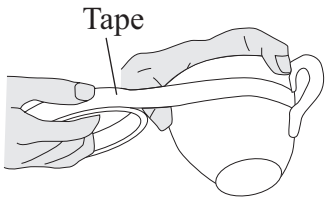
Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.



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.

State how the temperature of the mixture will change as the glue is mixed.

.....

.....

(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.

Explain why substances with giant covalent structures have high melting points.

.....

.....

.....

.....

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(2 marks)

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

Explain, in terms of particles, why increasing the temperature changes the rate of the reaction which causes the glue to set.

.....

.....

.....

.....

.....

(2 marks)

5

Areas outside the box will not be scanned for marking

5 Read the article and then answer the questions.

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.



'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.

5 (a) What is the meaning of *nanosize*?

.....

.....

(1 mark)

5 (b) Suggest why using 'nanocoated' tennis balls would be good for the environment.

.....

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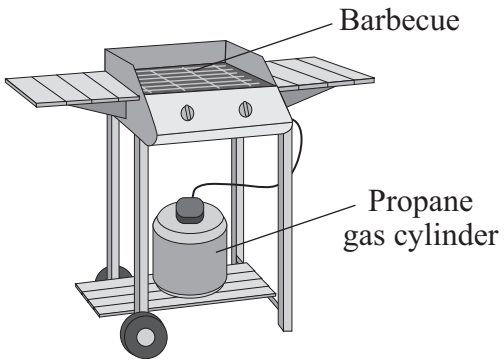
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(2 marks)

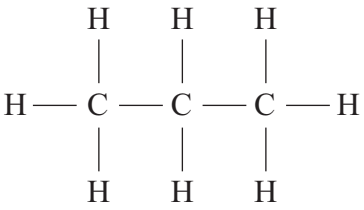
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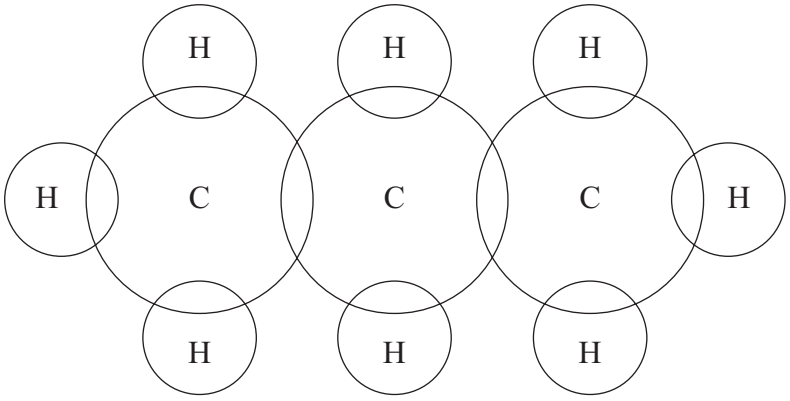
6 This barbecue burns propane gas.



The structure of propane is shown below.



6 (a) Complete the diagram to show how the outer energy level (shell) electrons of hydrogen and carbon are arranged in a molecule of propane.



(1 mark)

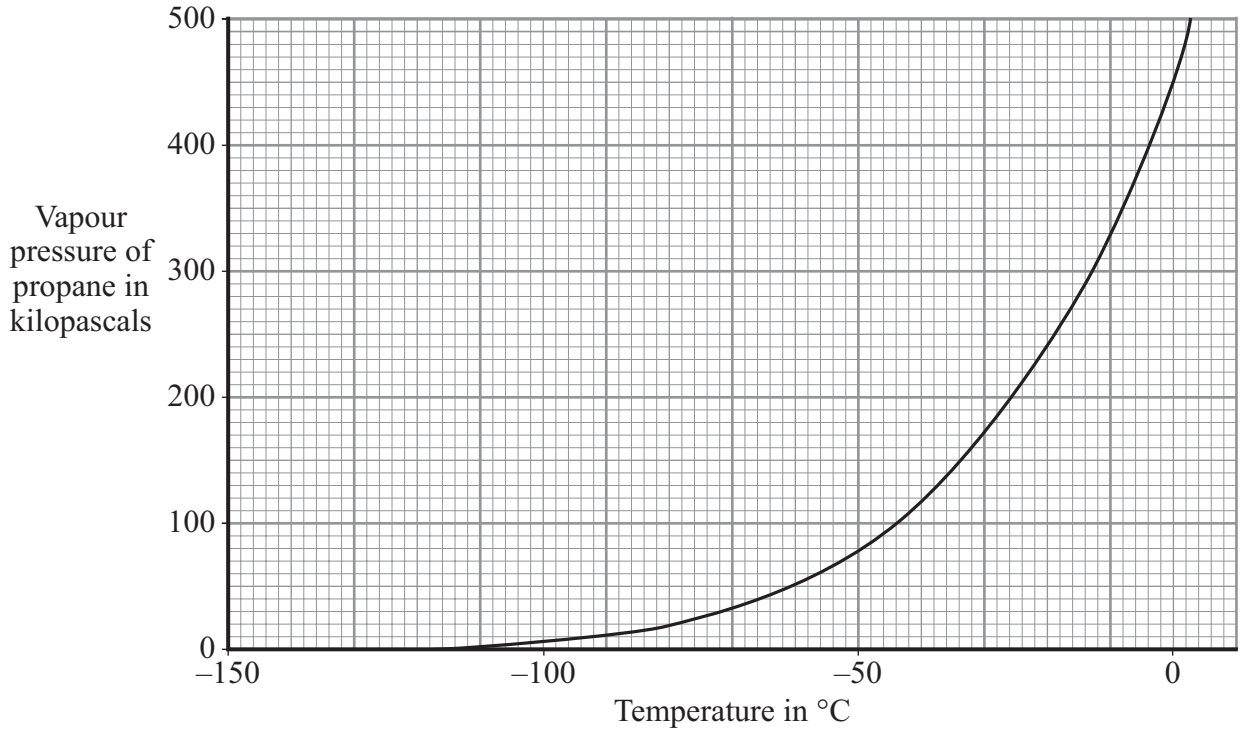
Question 6 continues on the next page

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6 (b) The graph shows how the vapour pressure of propane changes with temperature.

The vapour pressure of a liquid is the pressure of the vapour above the liquid.



6 (b) (i) Describe, as fully as you can, how the vapour pressure of propane changes with temperature.

.....

.....

.....

.....

.....

(2 marks)

6 (b) (ii) The boiling point of a liquid is the temperature at which its vapour pressure is equal to the air pressure above the liquid.

Use the graph to find the boiling point of propane when the air pressure is 100 kilopascals.

Boiling point ..... °C

(1 mark)

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6 (c) Explain, in terms of molecules, why propane has a low boiling point.

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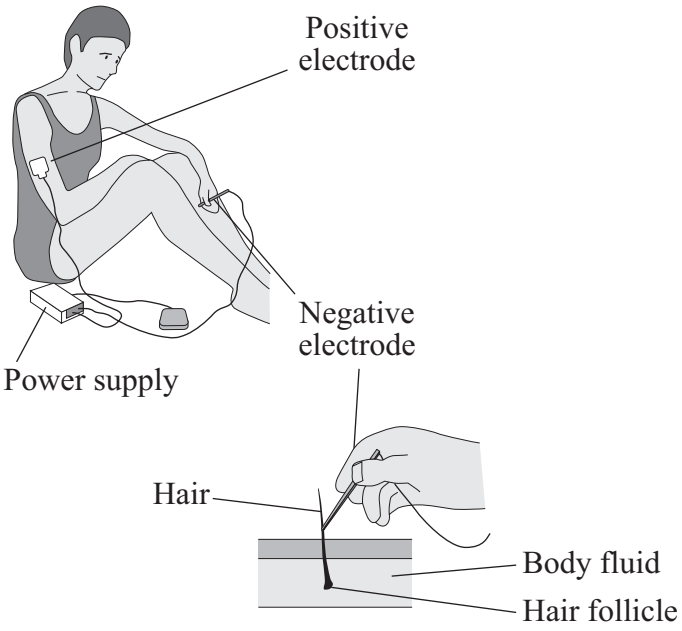
(2 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

7 Electrolysis can be used to remove unwanted hair from the skin.



The hair is first coated with a layer of gel containing ions in solution.

The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair. Electricity flows through the gel and causes electrolysis of the body fluid around the hair follicle.

7 (a) Metal wires conduct electricity to the electrodes.

Explain how metals conduct electricity.

.....

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.....

.....

(2 marks)

7 (b) Explain why the gel containing ions in solution can conduct electricity.

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

7 (c) The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

This solution contains hydrogen ions that move to the negative electrode.

7 (c) (i) The half equation represents the reaction at the negative electrode.

$$2H^+ + 2e^- \rightarrow H_2$$

Explain why this reaction is a reduction.

.....

.....

(1 mark)

7 (c) (ii) As a result of the electrolysis of sodium chloride solution, an alkali forms which kills the hair follicle.

What is the name of this alkali? .....

(1 mark)

7 (c) (iii) Complete the half equation for the reaction at the positive electrode.

$$Cl^- \rightarrow Cl_2$$

(1 mark)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

8 Aspirin tablets have important medical uses.



A student carried out an experiment to make aspirin. The method is given below.

1. Weigh 2.00 g of salicylic acid.
2. Add 4 cm^3 of ethanoic anhydride (an excess).
3. Add 5 drops of concentrated sulfuric acid.
4. Warm the mixture for 15 minutes.
5. Add ice cold water to remove the excess ethanoic anhydride.
6. Cool the mixture until a precipitate of aspirin is formed.
7. Collect the precipitate and wash it with cold water.
8. The precipitate of aspirin is dried and weighed.

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

$$\underset{\text{salicylic acid}}{C_7H_6O_3} + C_4H_6O_3 \rightarrow \underset{\text{aspirin}}{C_9H_8O_4} + CH_3COOH$$

Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.

The relative formula mass (M_r) of salicylic acid, $C_7H_6O_3$, is 138

The relative formula mass (M_r) of aspirin, $C_9H_8O_4$, is 180

.....

.....

.....

.....

Maximum mass of aspirin = ... g

(2 marks)

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8 (b) The student made 1.10 g of aspirin from 2.00 g of salicylic acid.

Calculate the percentage yield of aspirin for this experiment.

(If you did not answer part (a), assume that the maximum mass of aspirin that can be made from 2.00 g of salicylic acid is 2.50 g. This is **not** the correct answer to part (a).)

.....

.....

.....

.....

Percentage yield of aspirin = ... %

(2 marks)

8 (c) Suggest **one** possible reason why this method does **not** give the maximum amount of aspirin.

.....

.....

(1 mark)

8 (d) Concentrated sulfuric acid is a catalyst in this reaction.

Suggest how the use of a catalyst might reduce costs in the industrial production of aspirin.

.....

.....

(1 mark)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

9 Methanol is a fuel that is used in some racing cars instead of petrol.

Methanol can be made from carbon monoxide and hydrogen. The equation for this reaction is shown below.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The forward reaction is exothermic.

9 (a) A high pressure (between 50 and 100 atmospheres) is used in this process.

Explain why the highest equilibrium yield of methanol is obtained at high pressure.

.....

.....

(1 mark)

9 (b) The temperature used in this process is about 250 °C.

It has been stated that, 'the use of this temperature is a compromise between the equilibrium yield of product and the rate of reaction'.

Explain this statement.

.....

.....

.....

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.....

.....

.....

(3 marks)

4

END OF QUESTIONS

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H 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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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.

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COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

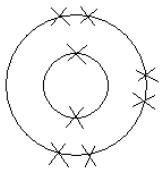
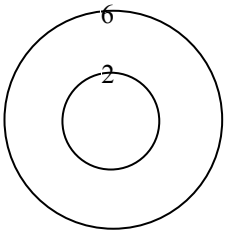
question	answers	extra information	mark
1(a)	152	correct answer with **or** without working = **2 marks** 56 + 32 + (4 ×16) gains **1** mark ignore any units	2
1(b)	152g(rams)	ecf from the answer to (a) and g must have unit g / gram / gramme / grams etc accept g / mol **or** g per mole **or** g $mole^{-1}$ **or** g/mol **or** g per mol **or** g mol^{-1} do **not** accept g m do **not** accept G	1
1(c)	76(g)	ecf from their answer to (a) or (b) divided by 2 ignore units	1
Total			**4**

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question	answers	extra information	mark
2(a)(i)	 **or** 	allow any arrangement of electrons on the shells accept o, x, - **or** e as representing electrons	1
2(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 2 continued on next page...

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COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 2 continued...

question	answers	extra information	mark
2(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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STATUS: Final

DATE: January 2009

question	answers	extra information	mark
3(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
3(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
3(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
3(d)(i)	nitric (acid)	Spelling must be correct accept HNO_3 correctly written ignore hydrogen nitrate	1
3(d)(ii)	evaporate **or** allow to crystallise	allow heat / boil / cool do **not** allow freeze ignore filtration ignore distillation	1

Question 3 continued on next page...

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Question 3 continued...

question	answers	extra information	mark
3(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**

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question	answers	extra information	mark
4(a)(i)	increase (owtte) **or** gets hotter	ignore gives out heat / takes in heat	1
4(a)(ii)	any **two** from: • <u>bonds</u> are strong • a lot of energy needed to break bonds • <u>all</u> atoms are joined by (covalent) bonds • a large number of bonds would need to be broken	accept hard to break allow heat for energy accept forms lattice reference to ionic / metallic = **1** mark intermolecular forces /forces between molecules = max **1** mark ignore electrostatic many strong bonds need to be broken = **2** marks accept 'double bonds' as equivalent to bonds	2

Question 4 continued on next page…

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Question 4 continued…

question	answers	extra information	mark
4(b)	any **two** from: • particles have more energy • particles move faster • particles collide more often **or** more collisions • more particles / particle collisions have the activation energy **or** more of the particles / particle collisions have enough energy to react **or** collisions are more energetic / harder (owtte) **or** more of the collisions are successful	 ignore more vibrations ignore move more accept answers such as hit / bump if electrons rather than particles stated then max **1** mark there are more collisions and more of the collisions are successful = **2** marks accept more collisions per second / unit of time for **2** marks accept 'more successful collisions' for **1** mark	2
Total			**5**

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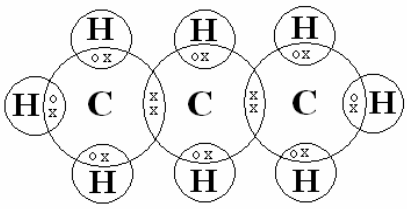
question	answers	extra information	mark
5(a)	1–100 nm in size **or** a few (hundred) atoms in size	accept very / really small / tiny **or** 10^{-9} accept billionth of a metre **or** any number that implies very small accept measured in nanometres if answer 'very small' ignore incorrect numerical values	1
5(b)	any **two** from: • less tennis balls need to be made • tennis balls last longer **or** don't have to replace as often • less materials / resources / fuel used up / saves resources • less energy used **or** making tennis balls uses energy • less pollution caused • less waste	accept saving materials accept saving energy accept named pollutant accept global warming / greenhouse effect eg fewer tennis balls going to landfill	2
Total			**3**

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question	answers	extra information	mark
6(a)		allow all dots **or** all crosses **or** combination **or** all e / e^- **or** – **or** other suitable symbols centre of symbols must be on **or** inside overlapping areas within reason	1
6(b)(i)	any **two** from: • no change initially **or** stays constant at the beginning • increase • slowly at first and then more rapidly	accept converse arguments allow vapour pressure is 0 at any temperature <–100°C for **1** mark accept positive correlation accept explanation based on kinetic theory eg particles have more kinetic energy allow reasonable attempt at using numbers	2
6(b)(ii)	–44 (using graph)	accept –43 to –45	1

Question 6 continued over page…

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Question 6 continued…

question	answers	extra information	mark
6(c)	• intermolecular forces / bonds **or** forces / bonds between molecules • bonds / forces are weak	**covalent** bonds are weak = **0** marks if they do not gain either of the marks on the left then allow simple covalent / molecular / made of small molecules for **1** mark	1 1
Total			**6**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

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question	answers	extra information	mark
7(a)	any **two** from: • outer shell electrons / electrons in highest energy level (in metals) • electrons are delocalised / sea of electrons • electrons are free **or** electrons move around **or** electrons are free to flow **or** electrons attracted to positive terminal • electrons carry charge / current **or** electrons form the current / electrons transfer charge / electrons pass charge	ignore electrons carry electricity ignore reference to positively charged atoms / ions if they state electrons have +ve charge = max **1** mark if they state covalent bonding then max **1** mark	2
7(b)	ions can move / are attracted to electrode **or** attracted to named electrode **or** ions are charged **or** ions form / carry the current **or** ions form the charge	accept ions are free allow 'they' for ions	1
7(c)(i)	electron gain	ignore hydrogen reduces charge	1
7(c)(ii)	sodium hydroxide **or** NaOH **or** caustic soda	do **not** allow hydroxide alone	1

Question 7 continued over page…

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 7 continued…

question	answers	extra information	mark
7(c)(iii)	$2Cl^- - 2e^- \rightarrow Cl_2$ **or** $2Cl^- \rightarrow Cl_2 + 2e^-$	allow fractions **or** multiples allow e **or** e^- do **not** allow e^+	1
Total			**6**

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question	answers	extra information	mark
8(a)	2.61 / range 2.5 to 2.7	correct answer with **or** without **or** with wrong working gains **2** marks (accept answers between 2.5 and 2.7) if answer incorrect moles of salicylic acid = 2/138 = 0.0145 moles ie 2/138 **or** 0.0145 gains **1** mark **or** (180/138) × 2 gains **1** mark **or** 1 g → 180/138 = (1.304 g) gains **1** mark (**not** 1.304g alone)	2
8(b)	42.1 range 40.7 to 42.3 if they do not have an answer to part (a) **or** they choose not to use their answer then: • yield = (1.1 / 2.5) × 100 (1) • = 44	accept correct answer with **or** without **or** with wrong working for **2** marks ecf ie (1.1 / their answer from (a)) × 100 correctly calculated gains **2** marks if answer incorrect percentage yield = 1.1 / 2.61 × 100 gains **1** mark accept 44 for **2** marks with no working	2

Question 8 continues on the next page...

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Question 8 continued...

question	answers	extra information	mark
8(c)	any **one** from: • errors in weighing • some (of the aspirin) lost • not all of the reactant may have been converted to product • the reaction is reversible • side reactions • reactants impure • not heated for long enough • not hot enough for reaction to take place	do **not** allow 'lost as a gas' eg reaction didn't go to completion allow loss of some reactants accept other products / chemicals ignore waste products	1
8(d)	any **one** from: • use lower temperature • use less fuel / energy • produce product faster **or** speed up reaction • more product produced in a given time (owtte) • increased productivity • lowers activation energy	ignore references to use of catalyst	1
Total			**6**

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question	answers	extra information	mark
9(a)	fewer product molecules than reactant molecules (owtte) **or** 3 reactant molecules and 1 product **or** 3 volumes of gas becomes 1 volume of gas	accept forward reaction produces fewer molecules accept left hand side for reactants and right hand side for products accept high pressure favours the side with fewer molecules ignore references to reaction rate	1
9(b)	any **three** from: • low temperature gives best yield **or** high temperature gives poor yield • because the reaction is exothermic • reaction too slow at low temperature **or** reaction faster at high temperature • temperature used gives a reasonable yield at a fast rate / compromise explained	 accept add heat as increased temperature **or** 'less' as poor yield accept reverse argument if clearly expressed accept add heat and reaction goes faster allow get less product but it takes less time for **2** marks	3
Total			**4**