AQA GCSE CHEMISTRY (4402)

# CHEMISTRY



## EXAM QUESTION PACK

UNIT C2 FOUNDATION TIER CH2FP PAPERS

STEMUP

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AQA

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Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

# GCSE

# ADDITIONAL SCIENCE CHEMISTRY

F

## Foundation Tier Unit Chemistry C2

Wednesday 15 June 2016 Afternoon Time allowed: 1 hour

**Materials**

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

You may use a calculator.

**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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 6(d) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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



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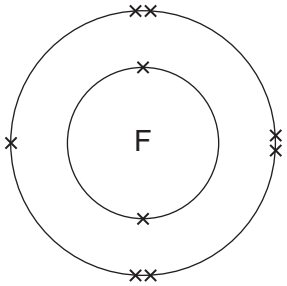
Do not write outside the box

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

**1** This question is about fluorine.

**1 (a)** **Figure 1** shows the arrangement of electrons in a fluorine atom.

**Figure 1**




**1 (a) (i)** In which group of the periodic table is fluorine?

**[1 mark]**

Group _____

**1 (a) (ii)** Complete **Table 1** to show the particles in an atom and their relative masses.

**[2 marks]**

**Table 1**

| Name of particle | Relative mass |
|---|---|
| Proton | |
| Neutron | 1 |
| | Very small |

**1 (a) (iii)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| **alkalis** | **alloys** | **isotopes** |
|---|---|---|

Atoms of fluorine with different numbers of neutrons are called _____ .

Do not write outside the box

**1 (b)** Sodium reacts with fluorine to produce sodium fluoride.

**1 (b) (i)** Complete the word equation for this reaction.

**[1 mark]**

sodium + _____ ⟶ _____

**1 (b) (ii)** Complete the sentence.

**[1 mark]**

Substances in which atoms of two or more different elements are chemically combined are called _____ .

**1 (b) (iii)** The relative formula mass ($M_r$) of sodium fluoride is 42.

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

**[1 mark]**

| ion | mole | molecule |
|---|---|---|

The relative formula mass ($M_r$), in grams, of sodium fluoride is one _____ of the substance.

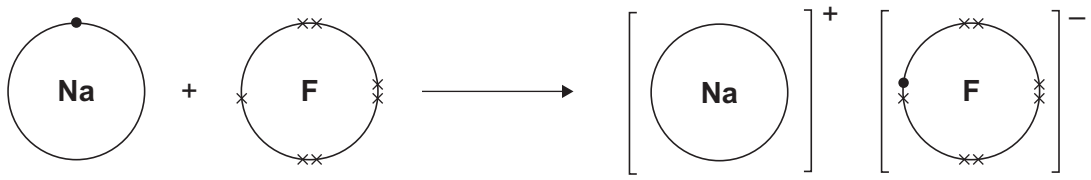
**Question 1 continues on the next page**

Do not write outside the box

**1 (b) (iv)** **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

**Figure 2**




Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

**[4 marks]**

Do not write outside the box

**1 (b) (v)** Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

**[2 marks]**

Tick (✓) **two** boxes.

Dissolve in water ☐

Gas at room temperature ☐

High melting point ☐

Low boiling point ☐

13

**Turn over for the next question**

Do not write outside the box

**2** This question is about substances containing carbon atoms.

**2 (a)** Diamond is made of carbon atoms.

**2 (a) (i)** Diamond is used for tips of drills.

**Figure 3** shows a drill.

**Figure 3**



Give **one** reason why diamond is used for tips of drills.

**[1 mark]**

_____

_____

**2 (a) (ii)** Diamond nanoparticles can be made.

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

**[1 mark]**

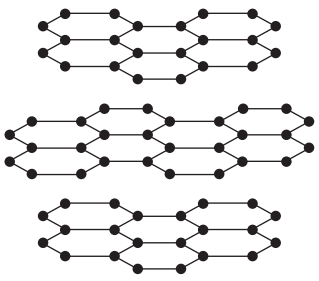
| | | |
|---|---|---|
| **hundred** | **million** | **thousand** |

Nanoparticles contain a few _____ atoms.

**2 (b)** Graphite is made of carbon atoms.

**Figure 4** shows the structure of graphite.

**Figure 4**



Do not write outside the box

**2 (b) (i)** What type of bonding does graphite have?

**[1 mark]**

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

**2 (b) (ii)** How many carbon atoms does each carbon atom bond to in graphite?

**[1 mark]**

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

**2 (b) (iii)** What is a property of graphite?

**[1 mark]**

Tick (✓) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

**Question 2 continues on the next page**

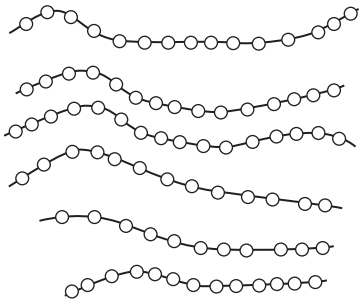
Do not write outside the box

**2 (c)** Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

**Figure 5** shows the structure of a thermosoftening polymer.

**Figure 5**



**2 (c) (i)** Complete the sentence.

**[1 mark]**

Between the polymer chains in a thermosoftening polymer there

are no _____ .

**2 (c) (ii)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **condense** | **dissolve** | **melt** |

Heating would cause a thermosoftening polymer to _____ .

**2 (c) (iii)** Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction. Suggest **two** conditions that could be changed.

**[2 marks]**

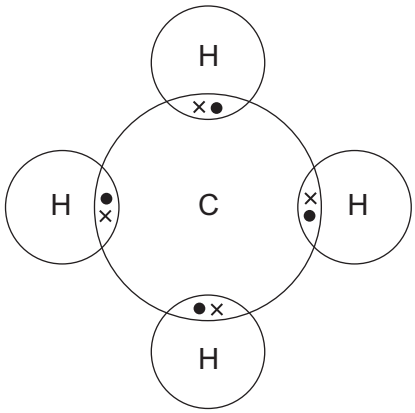
1 _____

2 _____

Do not write outside the box

**2 (d)** **Figure 6** shows how the atoms are bonded in methane.

**Figure 6**




**2 (d) (i)** What is the formula for methane?

**[1 mark]**

Tick (✓) **one** box.

$C_4H$ ☐

$CH_4$ ☐

$C_4H_4$ ☐

**2 (d) (ii)** Methane has a low boiling point.

What does methane consist of?

**[1 mark]**

Tick (✓) **one** box.

Charged ions ☐

A giant lattice ☐

Small molecules ☐

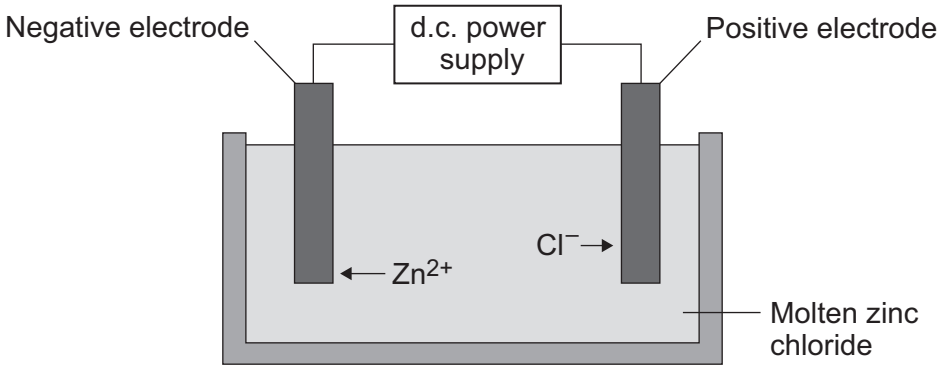
11

Do not write outside the box

**3** This question is about zinc.

**Figure 7** shows the electrolysis of molten zinc chloride.

**Figure 7**




**3 (a)** Zinc chloride is an ionic substance.
Complete the sentence.

**[1 mark]**

When zinc chloride is molten, it will conduct _____ .

**3 (b)** Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

**3 (b) (i)** Name the product formed at the positive electrode.

**[1 mark]**

_____

**3 (b) (ii)** Explain why zinc ions move towards the negative electrode.

**[2 marks]**

_____

_____

_____

_____

Do not write outside the box

**3 (b) (iii)** What type of reaction occurs when the zinc ions gain electrons?

**[1 mark]**

Tick (✓) **one** box.

Neutralisation ☐

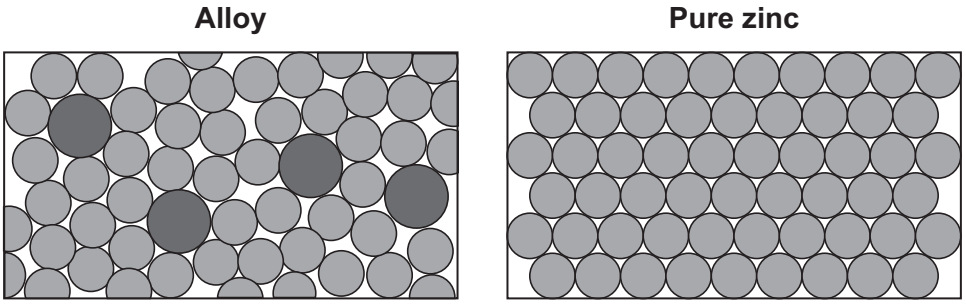
Oxidation ☐

Reduction ☐

**3 (c)** Zinc is mixed with copper to make an alloy.

**3 (c) (i)** **Figure 8** shows the particles in the alloy and in pure zinc.

**Figure 8**




Use **Figure 8** to explain why the alloy is harder than pure zinc.

**[2 marks]**

_____

_____

_____

_____

**3 (c) (ii)** Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

**[1 mark]**

_____

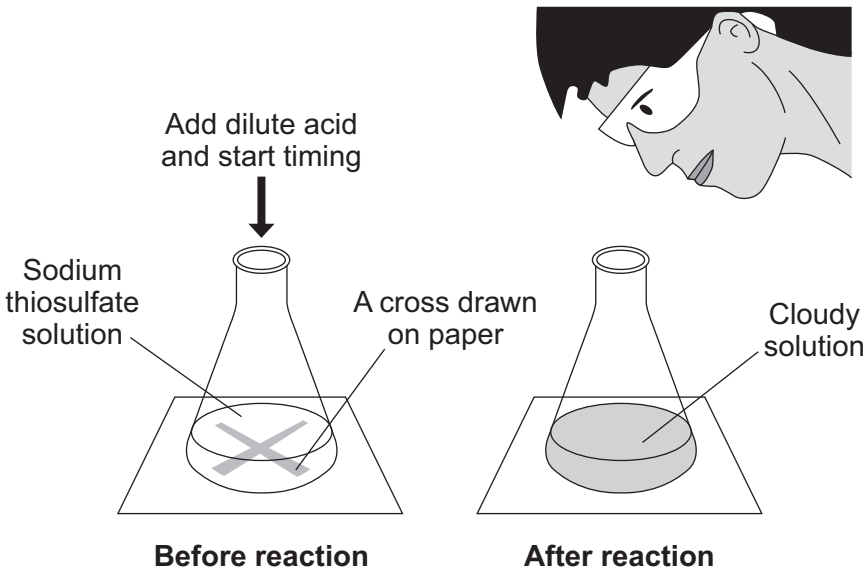
8

Do not write outside the box

**4** A student investigated the effect of temperature on the rate of a reaction.

**Figure 9** shows an experiment.

**Figure 9**




The student:

- put 50 $cm^3$ sodium thiosulfate solution into a conical flask
- heated the sodium thiosulfate solution to the required temperature
- put the flask on a cross drawn on a piece of paper
- added 5 $cm^3$ dilute hydrochloric acid and started a stopclock
- stopped the stopclock when the cross could no longer be seen
- repeated the experiment at different temperatures.

Do not write outside the box

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

| sodium thiosulfate | hydrochloric acid | sodium chloride | water | sulfur dioxide | sulfur |
|---|---|---|---|---|---|

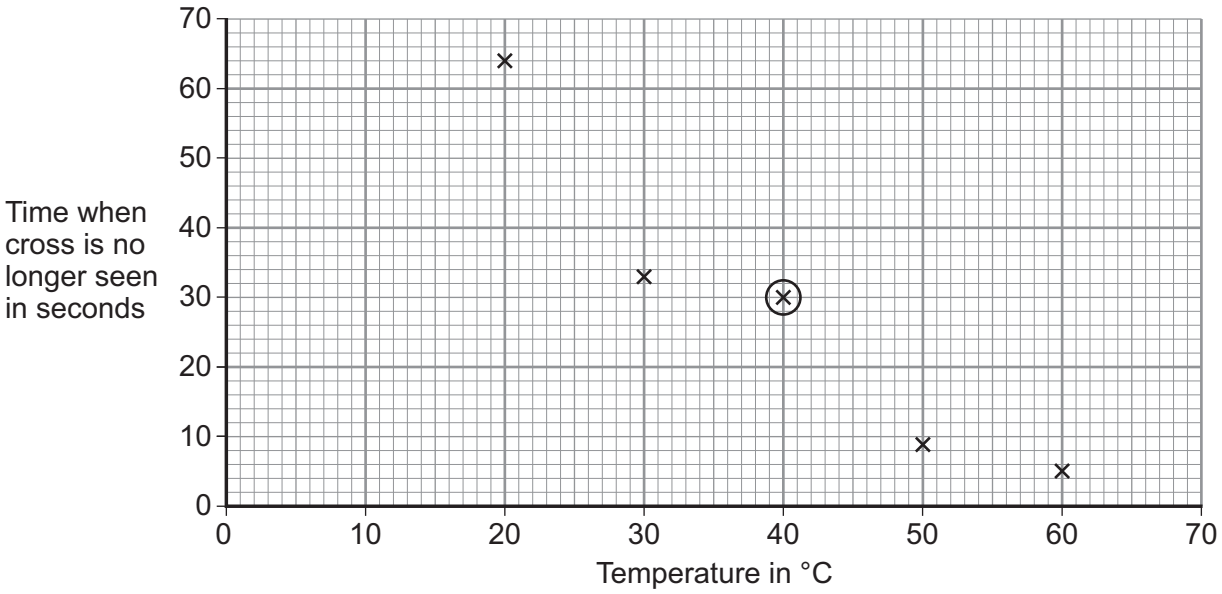
**4 (a)** Which product is a gas?

**[1 mark]**

_____

**4 (b)** **Figure 10** shows the results of this experiment at five different temperatures. The circled result point is anomalous.

**Figure 10**




**4 (b) (i)** Draw a line of best fit on **Figure 10** to show how the reaction time varied with reaction temperature.

**[1 mark]**

**4 (b) (ii)** Give a possible reason for the anomalous result at 40 °C.

**[1 mark]**

_____

_____

**Question 4 continues on the next page**

Do not write outside the box

**4 (b) (iii)** The reaction at 20 °C produced 0.32 g of sulfur in 64 seconds.

Calculate the rate of the reaction at 20 °C using the equation:

$$\text{Rate of reaction} = \frac{\text{mass of sulfur}}{\text{time}}$$

**[2 marks]**

Rate of reaction = _____ grams per second

**4 (b) (iv)** Give **two** reasons why the rate of the reaction increases as the temperature increases.

**[2 marks]**

Tick (✓) **two** boxes.

- The particles move faster. ☐
- The particles collide less often. ☐
- All the particles have the same energy. ☐
- The particles collide with more energy. ☐
- The number of particles increases. ☐

**4 (b) (v)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| activation | collision | exothermic |
|---|---|---|

The minimum amount of energy particles must have to react is called the _____ energy.

8

*Do not write outside the box*

**Turn over for the next question**

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**ANSWER IN THE SPACES PROVIDED**

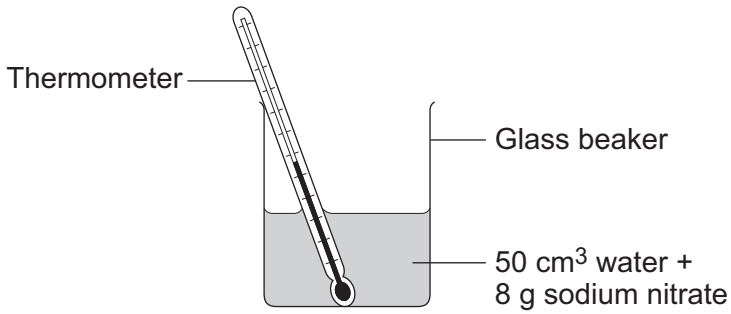
Do not write outside the box

**5** This question is about temperature changes.

**5 (a)** A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 $cm^3$ of water.

**Figure 11** shows the apparatus the student used.

**Figure 11**




The student did the experiment five times.
**Table 2** shows the results.

**Table 2**

| Experiment | Decrease in temperature of water in °C |
|---|---|
| 1 | 5.9 |
| 2 | 5.7 |
| 3 | 7.2 |
| 4 | 5.6 |
| 5 | 5.8 |

Do not write outside the box

**5 (a) (i)** Calculate the mean decrease in temperature.
Do not use the anomalous result in your calculation.

**[2 marks]**

Mean decrease in temperature = _____ °C

**5 (a) (ii)** Suggest **one** change in the apparatus in **Figure 11** which would improve the accuracy of the results.
Give a reason for your answer.

**[2 marks]**

**Question 5 continues on the next page**

Do not write outside the box

**5 (b)** The student investigated the temperature change when different masses of sodium carbonate were added to 50 $cm^3$ of water at 20 °C.

**Table 3** shows the results.

**Table 3**

| Mass of sodium carbonate in g | Final temperature of solution in °C |
|---|---|
| 2.0 | 21.5 |
| 4.0 | 23.0 |
| 6.0 | 24.5 |
| 8.0 | 26.0 |
| 10.0 | 26.6 |
| 12.0 | 26.6 |
| 14.0 | 26.6 |

Describe the relationship between the mass of sodium carbonate added and the final temperature of the solution.

Use values from **Table 3** in your answer.

**[3 marks]**

7

*Do not write outside the box*

**Turn over for the next question**

**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

Do not write outside the box

**6** This question is about ammonia and fertilisers.

**6 (a)** Ammonia is produced by a reversible reaction.

The equation for the reaction is:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Complete the sentence.

**[1 mark]**

The forward reaction is exothermic, so the reverse reaction is _____ .

**6 (b)** Calculate the percentage by mass of nitrogen in ammonia ($NH_3$).
Relative atomic masses ($A_r$): H = 1; N = 14
You **must** show how you work out your answer.

**[3 marks]**

_____

_____

_____

_____

_____

_____

Percentage by mass of nitrogen = _____%

Do not write outside the box

**6 (c)** A neutral solution can be produced when ammonia reacts with an acid.

**6 (c) (i)** Give the pH of a neutral solution.

**[1 mark]**

pH _____

**6 (c) (ii)** Which of these ionic equations shows a neutralisation reaction?

**[1 mark]**

Tick (✓) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

**6 (c) (iii)** Name the salt produced when ammonia reacts with hydrochloric acid.

**[1 mark]**

_____

**Question 6 continues on the next page**

Do not write outside the box

**6 (d)** **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Farmers use ammonium nitrate as a fertiliser for crops.

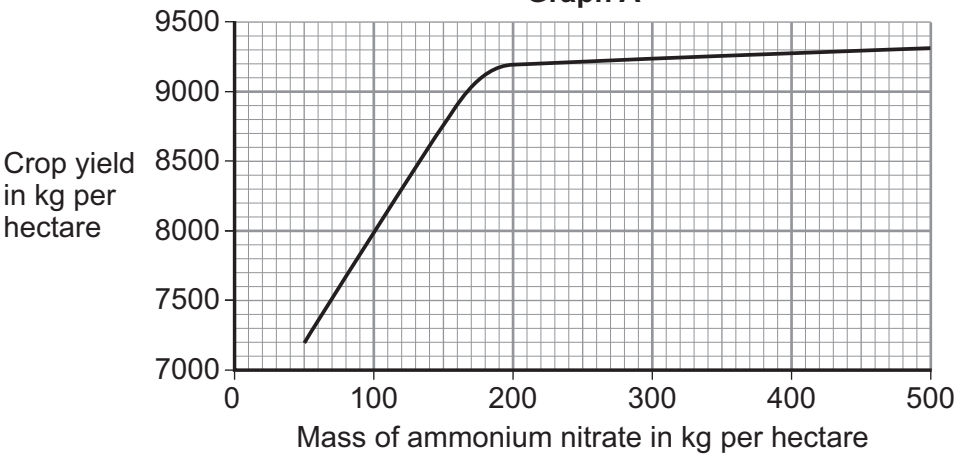
Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

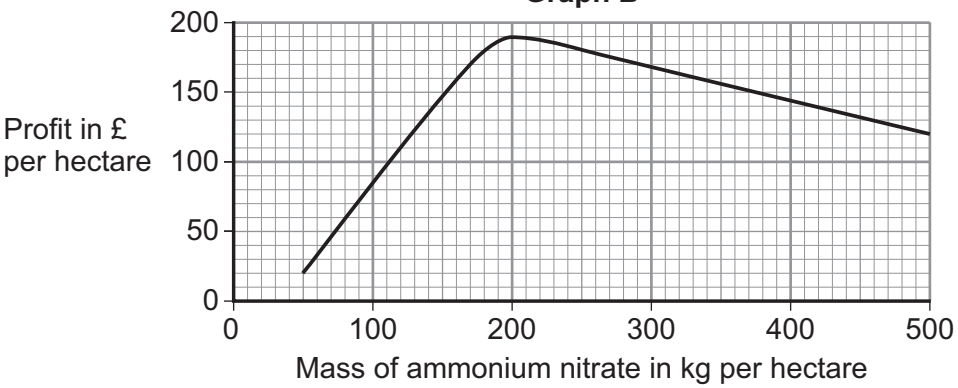
**Figure 12** shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

**Figure 12**

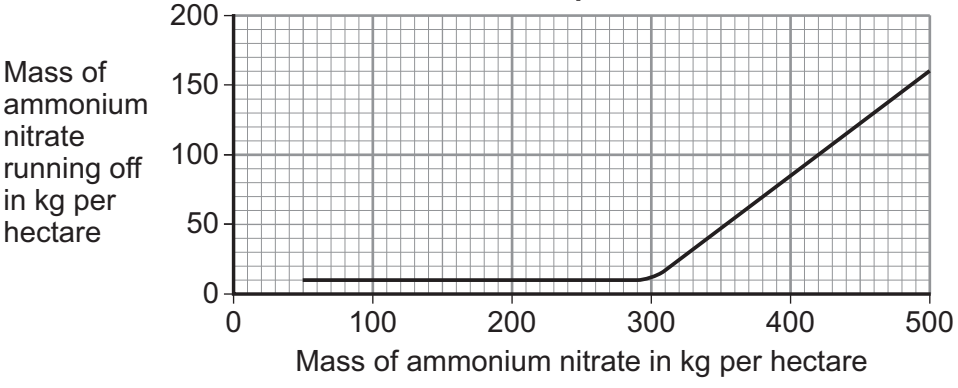
**Graph A**




**Graph B**




**Graph C**



Do not write outside the box

Suggest how much ammonium nitrate farmers should use per hectare.
Give reasons for your answer.
Use information from graphs **A**, **B** and **C**.

**[6 marks]**

Extra space

13

**END OF QUESTIONS**

**There are no questions printed on this page**

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**ANSWER IN THE SPACES PROVIDED**

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GCSE

# Additional Science / Chemistry

CH2FP

Mark scheme

4408 / 4402

June 2016

Version/Stage: 1.0 Final

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

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

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## 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 Assessment Objectives and specification content that each question is intended to cover.

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 and underlining

**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 bullet points 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.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 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 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | 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, 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 or by each stage of a longer calculation.

### 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 'ecf' 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.

### 3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

### 3.9 Ignore / Insufficient / Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

### 4. Quality of Written Communication and levels marking

In Question 6(d) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level.

**Level 1: Basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: Clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: Detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately
- The answer shows almost faultless spelling, punctuation and grammar.

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **1(a)(i)** | 7 / seven | | 1 | AO1<br>2.1.1e |
| **1(a)(ii)** | 1<br>Electron | do **not** accept -1 | 1<br>1 | AO1<br>2.3.1b |
| **1(a)(iii)** | isotopes | | 1 | AO1<br>2.3.1d |
| **1(b)(i)** | (sodium + ) fluorine → sodium fluoride | | 1 | AO2<br>2.1.1d,e |
| **1(b)(ii)** | compounds | | 1 | AO1<br>2.1.1a |
| **1(b)(iii)** | mole | | 1 | AO1<br>2.3.1g |
| **1(b)(iv)** | <br>sodium (atom) loses<br>fluorine (atom) gains<br>one electron<br>ions formed | **max 3** if reference to incorrect particle / bonding<br><br><br><br><br>allow sodium forms positive (ion) **or** fluorine forms negative (ion)<br>allow form ionic bond<br>allow to gain a full outer shell of electrons<br>allow forms noble gas structure | <br>1<br>1<br>1<br>1 | AO1 / AO2<br>2.1.1b,c,d,e,f |
| **1(b)(v)** | Dissolve in water<br>High melting point | | 1<br>1 | AO1<br>2.2.2a,b |
| **Total** | | | **13** | |



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| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **2(a)(i)** | hard | ignore strong | 1 | AO2<br>2.2.3b |
| **2(a)(ii)** | hundred | | 1 | AO1<br>2.2.6a |
| **2(b)(i)** | Covalent | | 1 | AO1<br>2.2.3a |
| **2(b)(ii)** | 3 | | 1 | AO1<br>2.2.3.c |
| **2(b)(iii)** | Soft and slippery | | 1 | AO1<br>2.2.3a,c |
| **2(c)(i)** | cross-links | allow bonds<br>ignore links<br>do **not** accept intermolecular | 1 | AO1<br>2.2.5b |
| **2(c)(ii)** | melt | | 1 | AO1<br>2.2.5b |
| **2(c)(iii)** | any **two** from**:**<br>• temperature<br>• pressure<br>• catalyst | allow heat(ing) | 2 | AO1 / AO3<br>2.2.5a |
| **2(d)(i)** | $CH_4$ | | 1 | AO1<br>2.1.1g |
| **2(d)(ii)** | Small molecules | | 1 | AO1<br>2.2.1a |
| **Total** | | | **11** | |



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| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **3(a)** | electricity | allow an electric current | 1 | AO1<br>2.7.1a;<br>2.2.2b |
| **3(b)(i)** | chlorine/$Cl_2$ | do **not** accept chloride | 1 | AO2<br>2.7.1b |
| **3(b)(ii)** | (zinc ions are) positive<br>and (opposite charges) attract | ignore to gain electrons | 1<br>1 | AO1/AO2<br>2.7.1c |
| **3(b)(iii)** | reduction | | 1 | AO1<br>2.7.1e |
| **3(c)(i)** | in alloy:<br>different sized atoms/particles<br>**or**<br>no layers/rows<br><br>so cannot slide | accept converse<br>accept layers distorted | <br>1<br><br><br>1 | AO1/AO2<br>2.2.4b,c |
| **3(c)(ii)** | shape memory (alloys) | accept smart | 1 | AO1<br>2.2.4d |
| **Total** | | | **8** | |



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| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **4(a)** | sulfur dioxide | accept $SO_2$ | 1 | AO2<br>2.6.1a |
| **4(b)(i)** | curved line of best fit between the 4 non-anomalous points | | 1 | AO2<br>2.4.1a |
| **4(b)(ii)** | temperature was lower (than 40 °C) | accept student missed the moment when the cross disappeared<br>accept smaller volume of acid or acid more dilute | 1 | AO3<br>2.4.1c |
| **4(b)(iii)** | 0.005 **or** 1/200 | correct answer with or without working gains **2** marks<br>if answer incorrect, allow **1** mark for 0.32 / 64 | 2 | AO2<br>2.4.1a |
| **4(b)(iv)** | The particles move faster.<br>The particles collide with more energy. | | 1<br>1 | AO1<br>2.4.1c |
| **4(b)(v)** | activation | | 1 | AO1<br>2.4.1.b |
| **Total** | | | **8** | |



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| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **5(a)(i)** | 5.75 **or** 5.8 | correct answer with or without working gains **2** marks<br>correct working showing addition of any four results and division by 4 gains **1** mark<br>**OR**<br>6(.04) for **1** mark | 2 | AO2/AO3 2.5.1a,c |
| **5(a)(ii)** | use a polystyrene cup **or** lid<br>to prevent energy/heat gain<br>**OR**<br>use a digital thermometer<br>easier to read (to 0.1°C) | accept insulate the beaker<br>accept to prevent energy/heat transfer<br>do **not** accept energy/heat loss<br>allow use a data logger | 1<br>1 | AO3 2.5.1a,c |
| **5(b)** | (as mass increases) the final temperature increases<br>then stays constant<br>correct reference to a value above 8 g up to and including 10 g as mass when the trend changes | | 1<br>1<br>1 | 2AO2 / 1AO3 2.5.1b |
| **Total** | | | **7** | |



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| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **6(a)** | endothermic | | 1 | AO1 2.5.1d |
| **6(b)** | 82 (%) | correct answer with working gains **3** marks<br>if 17 or 34 not shown in working **max 2** marks<br>accept 82.4<br>accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf<br>if no answer or incorrect answer, then<br>*($M_r$ =)* 17 gains **1** mark **or**<br>14/17 gains **2** marks<br>**OR**<br>*($2M_r$ =)* 34 gains **1** mark **or**<br>28/34 gains **2** marks<br>**OR**<br>14/their $M_r$ shown gains **1** mark **or**<br>correct calculation of 14/their $M_r$ gains **2** marks | 3 | AO2 2.3.3a, 2.3.1f |
| **6(c)(i)** | 7 / seven | | 1 | AO1 2.6.2d |
| **6(c)(ii)** | $H^+ + OH^- \rightarrow H_2O$ | | 1 | AO1 2.6.2e |
| **6(c)(iii)** | ammonium chloride | allow $NH_4Cl$<br>ignore an incorrect formula | 1 | AO1 2.6.2b |

**Question 6 continues on the next page**



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**Question 6 continued**

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **6(d)** | | | 6 | 2AO2 / 4AO3 2.6.2c |

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content. | Suggestion with a reference to a graph. | Suggestion with reasons referring to more than one graph. | Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise. |

**Examples of chemistry points made in response:**

A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha). Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

**Yield:**

- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

**Profit:**

- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

**Run off:**

- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

**Examples of linking of ideas:**

- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

**Examples of compromise:**

- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

| Total | | | 13 |
|---|---|---|---|



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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
Foundation Tier
June 2015

# Additional Science
**Unit Chemistry C2**

**CH2FP**

**F**

# Chemistry
**Unit Chemistry C2**

Thursday 14 May 2015 9.00 am to 10.00 am

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

You may use a calculator.

A

## Time allowed
- 1 hour

## 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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 6(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

## 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** This question is about carbon and gases in the air.

**1 (a)** Carbon atoms have protons, neutrons and electrons.

Complete **Table 1** by writing the relative mass of a neutron and an electron.

**[2 marks]**

**Table 1**

| Name of particle | Relative mass |
|---|---|
| proton | 1 |
| neutron | |
| electron | |

**1 (b)** What is the total number of protons and neutrons in an atom called?

**[1 mark]**

Tick (✓) **one** box.

The atomic number ☐

The mass number ☐

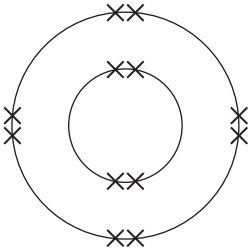
One mole of the atom ☐

**1 (c)** An atom of carbon has six electrons.

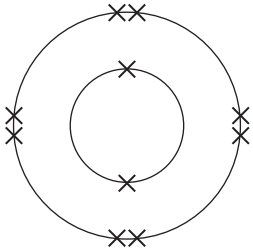
Which structure, **A**, **B** or **C**, represents the electronic structure of the carbon atom?

**[1 mark]**

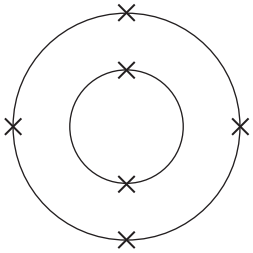
**Structure A**



**Structure B**



**Structure C**



The carbon atom is structure ☐.

Do not write outside the box

**1 (d)** Carbon reacts with oxygen to produce carbon dioxide ($CO_2$).

**1 (d) (i)** How many different elements are in one molecule of carbon dioxide?

**[1 mark]**

.....

**1 (d) (ii)** What is the total number of atoms in one molecule of carbon dioxide?

**[1 mark]**

.....

**1 (e)** Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

**1 (e) (i)** Calculate the relative formula mass ($M_r$) of carbon monoxide.

Relative atomic masses ($A_r$): C = 12; O = 16

**[1 mark]**

.....

.....

$M_r$ of carbon monoxide = .....

**1 (e) (ii)** Calculate the percentage by mass of carbon in carbon monoxide.

**[1 mark]**

.....

.....

Percentage by mass of carbon in carbon monoxide = .....%

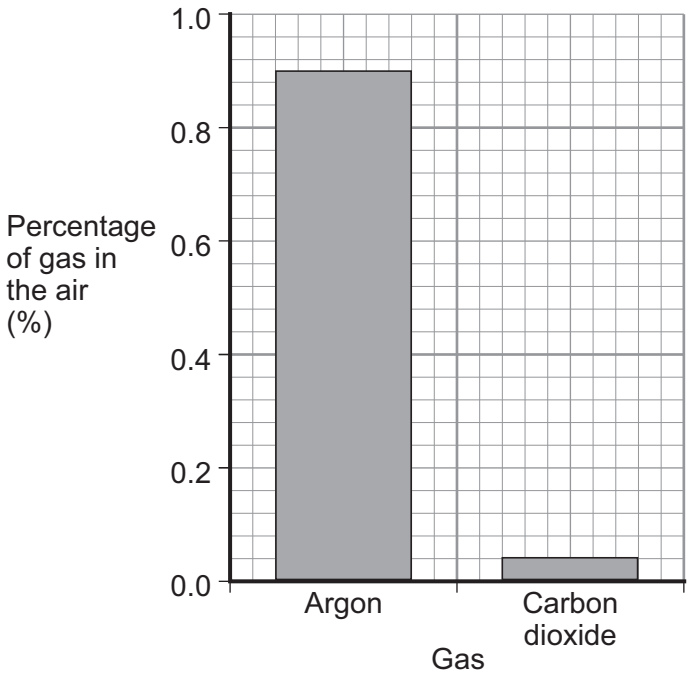
**Question 1 continues on the next page**

Do not write outside the box

**1 (f)** Carbon dioxide is one of the gases in the air.

**1 (f) (i)** **Figure 1** shows the percentage of argon and the percentage of carbon dioxide in the air.

**Figure 1**




What is the percentage of argon in the air?

**[1 mark]**

Percentage of argon = ..... %

**1 (f) (ii)** An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

**[1 mark]**

.....

.....

10

Do not write outside the box

**2** This question is about salts.

**2 (a)** Salt (sodium chloride) is added to many types of food.

Sodium chloride is produced by reacting sodium with chlorine.

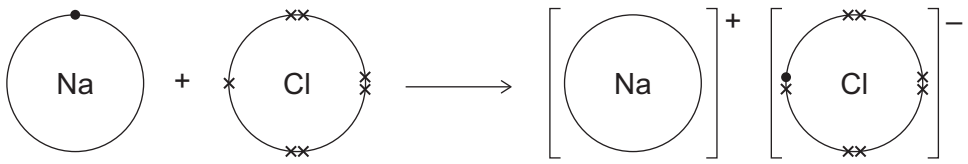
sodium + chlorine ⟶ sodium chloride

**Figure 2** shows what happens to atoms of sodium and chlorine in this reaction.

The dots (•) and crosses (×) represent electrons.

Only the outer electrons are shown.

**Figure 2**




Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

**[3 marks]**

.....

.....

.....

.....

.....

.....

**Question 2 continues on the next page**

Do not write outside the box

**2 (b)** Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

**2 (b) (i)** Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

**[1 mark]**

Tick (✓) **one** box.

Have no overall electric charge ☐

Have high boiling points ☐

Have giant covalent structures ☐

**2 (b) (ii)** Which one of the following questions cannot be answered by science alone?

**[2 marks]**

Tick (✓) **one** box.

How much sodium chloride is in food? ☐

What harm does a lack of iodine do? ☐

Should iodine be added to salt in food? ☐

Give **one** reason why this question cannot be answered by science alone.

.....

.....

**2 (c)** A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

**2 (c) (i)** Name the acid used.

**[1 mark]**

.....

Do not write outside the box

**2 (c) (ii)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| an acid | an alkali | a salt |
|---|---|---|

Ammonia solution (ammonium hydroxide) is ..... .

**2 (c) (iii)** The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

**[1 mark]**

The solution added is an ..... .

**2 (d)** Farmers buy solid ammonium nitrate in poly(ethene) sacks.

**2 (d) (i)** How is solid ammonium nitrate made from a solution of ammonium nitrate?

**[1 mark]**

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

**2 (d) (ii)** Why do farmers use ammonium nitrate on their fields?

**[1 mark]**

.....

.....

**2 (d) (iii)** The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

**[1 mark]**

.....

.....

12

**Turn over ▶**

Do not write outside the box

**3** Lead iodide is an insoluble salt.

**3 (a)** What type of substance is lead iodide?

**[1 mark]**

Tick (✓) **one** box.

An element ☐

A mixture ☐

A compound ☐

**3 (b)** A student produced lead iodide by a precipitation reaction.

Use the correct answers from the box to complete the word equation.

**[2 marks]**

| **lead bromide** | **lead nitrate** | **potassium bromide** | **potassium iodide** |
|---|---|---|---|

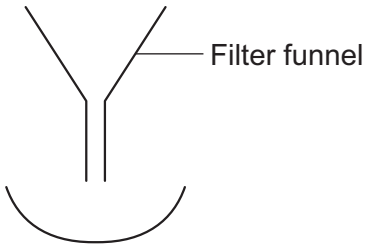
..... + ..... ⟶ lead iodide + potassium nitrate

Do not write outside the box

**3 (c)** The student wanted to separate the precipitate of lead iodide from the solution by using filtration.

The student used the apparatus shown in **Figure 3**.

**Figure 3**




Explain why the apparatus in **Figure 3** would **not** separate the lead iodide from the mixture.

**[2 marks]**

.....

.....

.....

.....

**3 (d)** The student expected to get 5 g of lead iodide but only got 3 g.

**3 (d) (i)** The student did this calculation.

$\frac{3}{5} \times 100$

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

**[1 mark]**

| | | |
|---|---|---|
| **mass of one mole** | **percentage yield** | **relative formula mass** |

The student calculated the ..... .

**3 (d) (ii)** Give **one** reason why the mass the student got was less than expected.

**[1 mark]**

.....

.....

7

Do not write outside the box

**4** This question is about electrolysis.

**4 (a)** Metal spoons can be coated with silver.
This is called electroplating.

Suggest **one** reason why spoons are electroplated.

**[1 mark]**

.....

.....

**4 (b)** When sodium chloride solution is electrolysed the products are hydrogen and chlorine.

**4 (b) (i)** What is made from chlorine?

**[1 mark]**

Tick (✓) **one** box.

Bleach ☐

Fertiliser ☐

Soap ☐

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

Why is hydrogen produced at the negative electrode and **not** sodium?

**[1 mark]**

Tick (✓) **one** box.

Hydrogen is a gas. ☐

Hydrogen is less reactive than sodium. ☐

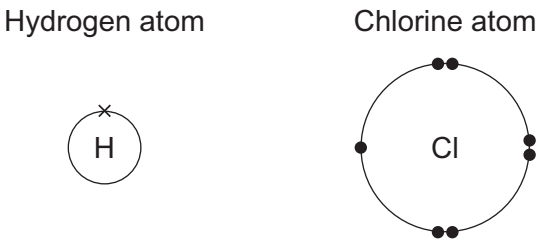
Hydrogen ions move faster than sodium ions. ☐

Do not write outside the box

**4 (b) (iii)** Hydrogen and chlorine can be used to produce hydrogen chloride.

The diagrams in **Figure 4** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

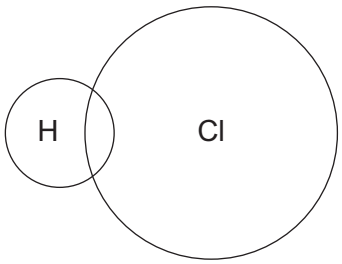
**Figure 4**




Complete **Figure 5** to show how the outer electrons are arranged in a molecule of hydrogen chloride (HCl).

**[1 mark]**

**Figure 5**




**4 (b) (iv)** What is the type of bond in a molecule of hydrogen chloride?

**[1 mark]**

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

**Question 4 continues on the next page**

Do not write outside the box

**4 (b) (v)** Why is hydrogen chloride a gas at room temperature (20 °C)?

**[2 marks]**

Tick (✓) **two** boxes.

Hydrogen chloride has a low boiling point. ☐

Hydrogen chloride has a high melting point. ☐

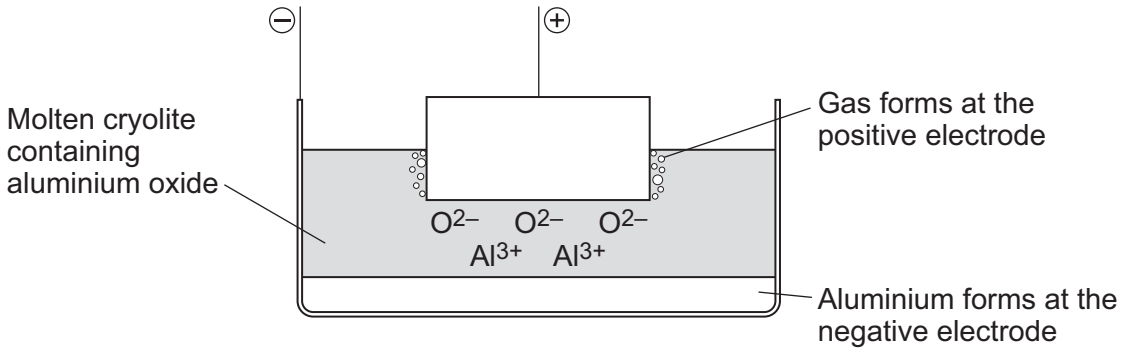
Hydrogen chloride is made of simple molecules. ☐

Hydrogen chloride does not conduct electricity. ☐

Hydrogen chloride has a giant structure. ☐

**4 (c)** Aluminium is produced by electrolysis of a molten mixture of aluminium oxide and cryolite.
This is shown in **Figure 6**.

**Figure 6**




**4 (c) (i)** Name a gas produced at the positive electrode.

**[1 mark]**

.....

Do not write outside the box

**4 (c) (ii)** Aluminium ions move to the negative electrode.

Explain why.

**[2 marks]**

.....

.....

.....

.....

**4 (c) (iii)** At the negative electrode, the aluminium ions gain electrons to produce aluminium.

What is this type of reaction called?

**[1 mark]**

Tick (✓) **one** box.

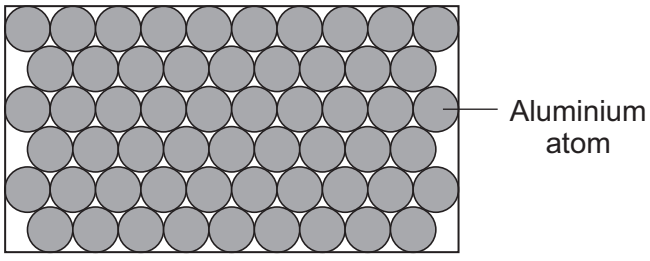
Combustion ☐

Oxidation ☐

Reduction ☐

**4 (c) (iv)** Aluminium has layers of atoms, as shown in **Figure 7**.

**Figure 7**




Complete the sentence.

**[1 mark]**

Metals can be bent and shaped because the layers of atoms can ..... .

**Question 4 continues on the next page**

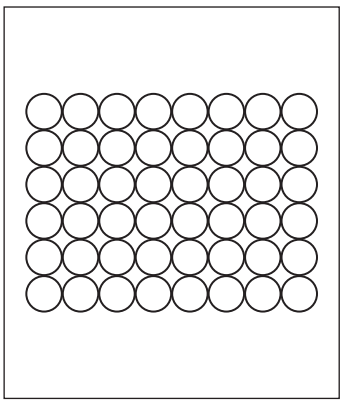
Do not write outside the box

**4 (d)** Electrodes used in the production of aluminium are made from graphite.

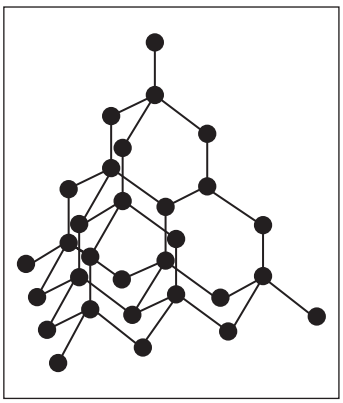
**4 (d) (i)** Which diagram, **A**, **B** or **C**, shows the structure of graphite?

**[1 mark]**

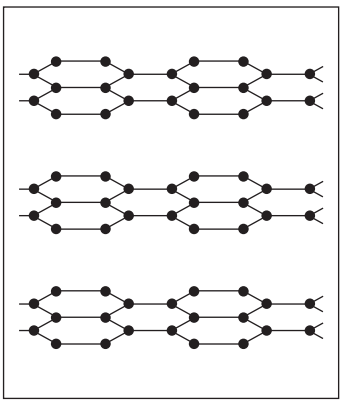
**A**



**B**



**C**



The structure of graphite is shown in diagram ☐.

**4 (d) (ii)** The temperature for the electrolysis is 950 °C.

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

**[1 mark]**

| | | |
|---|---|---|
| **cross links** | **a giant ionic lattice** | **strong covalent bonds** |

The graphite does not melt at 950 °C because

graphite has ..... .

14

*Do not write outside the box*

**Turn over for the next question**

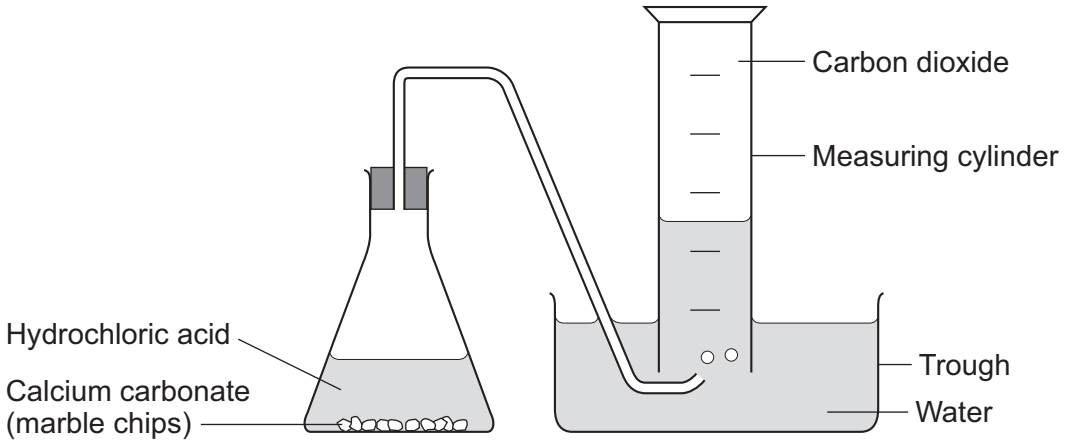
**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

Do not write outside the box

**5** A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student used the apparatus shown in **Figure 8**.

**Figure 8**




The student:

- recorded the volume of gas collected every 5 seconds
- repeated the experiment using hydrochloric acid at different temperatures.

The equation for the reaction is:

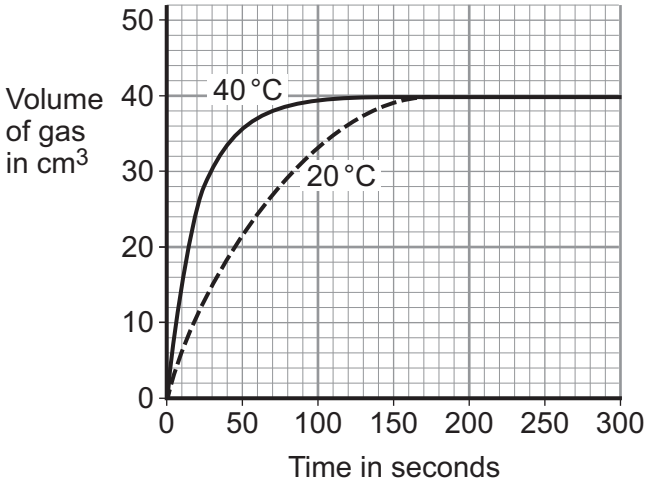
$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Do not write outside the box

**5 (a)** The student plotted results for the hydrochloric acid at 20 °C and 40 °C on a graph.

**Figure 9** shows the student's graph.

**Figure 9**




Use information from **Figure 9** to answer these questions.

**5 (a) (i)** State **one** conclusion the student could make about the effect of temperature on the rate of the reaction.

**[1 mark]**

.....

.....

**5 (a) (ii)** Give **one** reason why the student could make this conclusion.

**[1 mark]**

.....

.....

**5 (a) (iii)** For the hydrochloric acid at 60 °C the student had collected 30 $cm^3$ after 15 seconds.

Calculate the average rate of reaction from 0 to 15 seconds.

**[1 mark]**

.....

.....

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

**Turn over ▶**

Do not write outside the box

**5 (b)** The student then investigated how the surface area of marble chips affected the rate of reaction.

**5 (b) (i)** Which **two** variables should the student keep constant?

**[2 marks]**

Tick (✓) **two** boxes.

- Amount of water in the trough ☐
- Concentration of acid ☐
- Mass of marble chips ☐
- Size of marble chips ☐
- Volume of measuring cylinder ☐

**5 (b) (ii)** Explain, in terms of particles and collisions, the effect that increasing the surface area of the marble chips has on the rate of reaction.

**[2 marks]**

.....

.....

.....

.....

**5 (c)** Calcium carbonate is a catalyst for the industrial production of biodiesel.

Give **one** reason why using a catalyst reduces costs.

**[1 mark]**

.....

.....

8

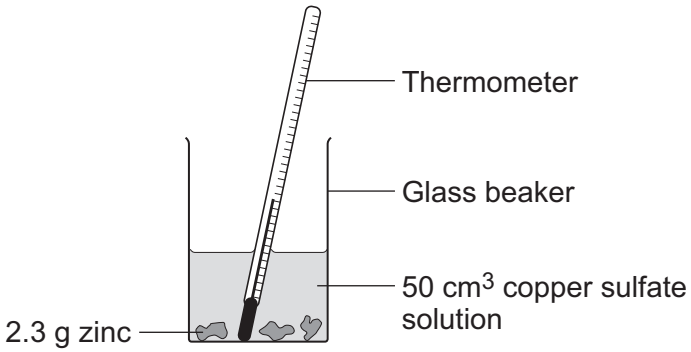
Do not write outside the box

**6** A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

The student used the apparatus shown in **Figure 10**.

**Figure 10**




The student:

- measured 50 $cm^3$ copper sulfate solution into a glass beaker
- measured the temperature of the copper sulfate solution
- added 2.3 g zinc
- measured the highest temperature
- repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:

$$Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$$

zinc + copper sulfate solution ⟶ copper + zinc sulfate solution

**6 (a)** The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

**[1 mark]**

.....

.....

**Question 6 continues on the next page**

**Turn over ▶**

Do not write outside the box

**6 (b)** Suggest **one** improvement the student could make to the apparatus in **Figure 10**.

Give a reason why this improves the investigation.

**[2 marks]**

Improvement .....

.....

Reason .....

.....

**6 (c)** **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The student's results are shown in **Table 2**.

**Table 2**

| Experiment number | Concentration of copper sulfate in moles per $dm^3$ | Increase in temperature in °C |
|---|---|---|
| 1 | 0.1 | 5 |
| 2 | 0.2 | 10 |
| 3 | 0.3 | 12 |
| 4 | 0.4 | 20 |
| 5 | 0.5 | 25 |
| 6 | 0.6 | 30 |
| 7 | 0.7 | 35 |
| 8 | 0.8 | 35 |
| 9 | 0.9 | 35 |
| 10 | 1.0 | 35 |

*Do not write outside the box*

Describe **and** explain the trends shown in the student's results.

**[6 marks]**

.....

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Extra space .....

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9

**END OF QUESTIONS**

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AQA

# GCSE

# Additional Science / Chemistry

CH2FP

Mark scheme

4408 / 4402
June 2015

Version/Stage: 1.0 Final

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

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 from aqa.org.uk

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## 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 Assessment Objectives and specification content that each question is intended to cover.

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 and underlining

**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 bullet points 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.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 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.

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

| Student | Response | Marks awarded |
|---|---|---|
| 1 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | 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, 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 or by each stage of a longer calculation.

**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 is 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.

**3.8 Ignore / Insufficient / Do <u>not</u> allow**

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

**Quality of Written Communication and levels marking**

In Question 6(c) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **1(a)** | <br>1<br>very small | must be in this order<br><br>accept negligible, 1/2000<br>allow zero | <br>1<br>1 | **AO1**<br>2.3.1b |
| **1(b)** | The mass number | | 1 | **AO1**<br>2.3.1c |
| **1(c)** | C | | 1 | **AO2**<br>2.3.1a |
| **1(d)(i)** | 2 | | 1 | **AO2**<br>2.1.1a |
| **1(d)(ii)** | 3 | | 1 | **AO2**<br>2.1.1a |
| **1(e)(i)** | 28 | | 1 | **AO2**<br>2.3.1f |
| **1(e)(ii)** | 42.9 | accept ecf from (e)(i)<br>accept 42 - 43 | 1 | **AO2**<br>2.3.3a |
| **1(f)(i)** | 0.9 | | 1 | **AO2**<br>2.3 |
| **1(f)(ii)** | any **one** from:<br>• accurate<br>• sensitive<br>• rapid<br>• small sample | | 1 | **AO1**<br>2.3.2a |
| **Total** | | | **10** | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **2(a)** | sharing/covalent/metallic = max 2<br><br>sodium loses (electron)<br><br>chlorine gains (electron)<br><br>1 **or** an (electron) | | <br><br>1<br><br>1<br><br>1 | **AO1/AO2**<br>2.1.1b,c,d, e,f |
| **2(b)(i)** | Have no overall electric charge | | 1 | **AO1**<br>2.2.1a,c |
| **2(b)(ii)** | Should iodine be added to salt?<br><br>reason:<br>any **one** from:<br>• cannot be done by experiment<br>• based on opinion / view<br>• ethical **or** economic issue | <br><br><br><br>accept difficult to get / not enough evidence<br><br>allow must be done by survey | 1<br><br><br><br>1 | **AO3**<br>2.2.1 |
| **2(c)(i)** | nitric (acid) | | 1 | **AO1**<br>2.6.2b |
| **2(c)(ii)** | an alkali | | 1 | **AO1**<br>2.6.2a |
| **2(c)(iii)** | indicator | accept any named acid base indicator | 1 | **AO1**<br>2.6.1b |
| **2(d)(i)** | Crystallisation | | 1 | **AO1**<br>2.6.1c |
| **2(d)(ii)** | fertiliser | allow to help crops grow | 1 | **AO1**<br>2.6.2c |
| **2(d)(iii)** | any **one** from:<br>• pressure<br>• temperature<br>• catalyst | <br>allow concentration<br>ignore heat | 1 | **AO1**<br>2.2.5a |
| **Total** | | | **12** | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3(a)** | A compound | | 1 | **AO1**<br>2.1.1a |
| **3(b)** | lead nitrate<br>potassium iodide | in either order | 1<br>1 | **AO2**<br>2.6.1d |
| **3(c)** | filter paper is missing<br>so solid will go through funnel | | 1<br>1 | **AO3**<br>2.6.1b |
| **3(d)(i)** | percentage yield | | 1 | **AO2**<br>2.3.3e |
| **3(d)(ii)** | any **one** from:<br>• some product lost<br>• reaction may not go to completion<br>• unexpected reaction<br>• impure reactants | allow insufficient reactant | 1 | **AO1**<br>2.3.3d |
| **Total** | | | **7** | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **4(a)** | any **one** from:<br>• protection/improve lifespan<br>• improve appearance | | 1 | **AO2**<br>2.7.1d |
| **4(b)(i)** | Bleach | | 1 | **AO1**<br>2.7.1i |
| **4(b)(ii)** | Hydrogen is less reactive than sodium. | | 1 | **AO2**<br>2.7.1f |
| **4(b)(iii)** | 1 bonding pair of electrons<br>6 unbonded electrons on Cl | accept dot, cross or e or – or any combination | 1 | **AO1**<br>2.7.1e |
| **4(b)(iv)** | Covalent | | 1 | **AO1**<br>2.7.1f |
| **4(b)(v)** | Hydrogen chloride has a low boiling point.<br>Hydrogen chloride is made of simple molecules. | | 1<br>1 | **AO1**<br>2.2.1a<br>2.1.1g |
| **4(c)(i)** | oxygen | accept carbon dioxide | 1 | **AO1**<br>2.7.1h |
| **4(c)(ii)** | aluminium ions are positive<br>so are attracted (to the negative electrode) | allow opposites attract | 1<br>1 | **AO1/AO2**<br>2.7.1h<br>2.2.2b |
| **4(c)(iii)** | Reduction | | 1 | **AO1**<br>2.7.1e |
| **4(c)(iv)** | slide | allow move | 1 | **AO1**<br>2.2.4b |
| **4(d)(i)** | C | | 1 | **AO1**<br>2.2.3a,c |
| **4(d)(ii)** | strong covalent bonds | | 1 | **AO1**<br>2.2.3a |
| **Total** | | | **14** | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **5(a)(i)** | the higher the temperature, the greater the rate<br><br>**or**<br>at 40 °C rate is faster than at 20 °C | accept the higher the temperature, the faster the reaction | 1 | **AO3**<br>2.4.1c |
| **5(a)(ii)** | 40 °C curve is steeper<br><br>**or**<br>correct comparison of data from the graph | accept the 40 °C line becomes horizontal sooner<br><br>accept at higher temperatures the reaction finishes sooner<br><br>accept reaction finishes sooner at 40 °C<br><br>accept at higher temperatures the gas is produced faster | 1 | **AO3**<br>2.4.1c |
| **5(a)(iii)** | 2 | | 1 | **AO2**<br>2.4.1a |
| **5(b)(i)** | Concentration of acid<br>Mass of marble chips | | 2 | **AO3**<br>2.4.1e |
| **5(b)(ii)** | <br>increases rate<br>(because of) more frequent collisions (between particles) | incorrect reference to energy = max **1**<br><br>accept particles are more likely to collide<br>ignore more collisions<br>ignore more successful collisions | <br>1<br>1 | **AO1**<br>2.4.1f |
| **5(c)** | any **one** from:<br>• increases rate of reaction<br>• reduces energy required<br>• lower temperature can be used<br>• catalyst is not used up | | 1 | **AO1**<br>2.4.1g,h |
| **Total** | | | **8** | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6(a)** | any **one** from:<br>• solution becomes colourless or colour fades<br>• zinc becomes bronze / copper coloured<br>• zinc gets smaller<br>• bubbles or fizzing | <br><br>allow copper (forms) or a solid (forms)<br>allow zinc dissolves<br>ignore precipitate | 1 | **AO2**<br>2.5.1 |
| **6(b)** | improvement:<br>use a plastic / polystyrene cup or add a lid<br>reason - must be linked<br>reduce / stop heat loss<br>**OR**<br>improvement:<br>use a digital thermometer<br>reason - must be linked<br>more accurate or easy to read or stores data | <br>accept use lagging/insulation<br><br><br><br><br>allow use a data logger<br><br>allow more precise or more sensitive<br>ignore more reliable<br>ignore improvements to method, eg take more readings | 1<br><br>1 | **AO3**<br>2.5.1a,b |

**Question 6 continues on the next page**



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**Question 6 continued**

**6(c)** Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

**AO2/AO3**
2.5.1a,b

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content. | There is a statement about the results. | There are statements about the results.<br>These statements may be linked or may include data. | There are statements about the results with at least one link and an attempt at an explanation. |

Examples of chemistry points made in the response:

**Description:**

**Statements**
Concentration of copper sulfate increases
Temperature change increases
There is an anomalous result
The temperature change levels off
Reaction is exothermic

**Linked Statements**
Temperature change increases as concentration of copper sulfate increases
The temperature change increases, and then remains constant
After experiment 7 the temperature change remains constant

**Statements including data**
The trend changes at experiment 7
Experiment 3 is anomalous

**Attempted Explanation:**
Temperature change increases because rate increases
Temperature change levels off because the reaction is complete

**Explanation:**
As more copper sulfate reacts, more heat energy is given off
Once copper sulfate is in excess, no further heat energy produced

| | | | |
|---|---|---|---|
| **Total** | | | **9** |



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| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

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

AQA

General Certificate of Secondary Education
Foundation Tier
June 2014

# Additional Science
**Unit Chemistry C2**

**CH2FP**

**F**

# Chemistry
**Unit Chemistry C2**

Thursday 15 May 2014 9.00 am to 10.00 am

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

You may use a calculator.

A

## Time allowed
- 1 hour

## 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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 7 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

## 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** This question is about diamonds.

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

**1 (a)** Diamonds are found in meteorites.

**1 (a) (i)** Meteorites get very hot when they pass through the Earth's atmosphere, but the diamonds do not melt.

Diamond has a (high / low / very low) melting point.

**[1 mark]**

**1 (a) (ii)** Most diamonds found in meteorites are nanodiamonds.

A nanodiamond contains a few (hundred / thousand / million) atoms.

**[1 mark]**

**1 (b)** Diamonds are used for the cutting end of drill bits.

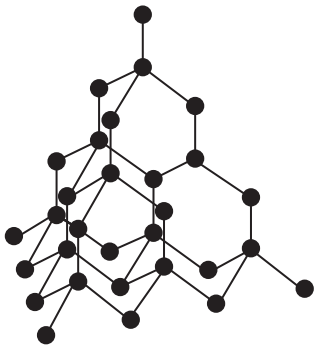
Diamonds can be used for drill bits because they are (hard. / shiny. / soft.)

**[1 mark]**

Do not write outside the box

**1 (c)** **Figure 1** shows the arrangement of atoms in diamond.

**Figure 1**



**1 (c) (i)** Diamond is made from [carbon / nitrogen / oxygen] atoms.

**[1 mark]**

**1 (c) (ii)** Each atom in diamond is bonded to [three / four / five] other atoms.

**[1 mark]**

**1 (c) (iii)** Diamond has a giant [covalent / ionic / metallic] structure.

**[1 mark]**

**1 (c) (iv)** In diamond [all / none / some] of the atoms are bonded together.

**[1 mark]**

7

Do not write outside the box

**2** Dental braces are made from nitinol wires. Nitinol is a mixture of metals.




**2 (a)** Nitinol can return to its original shape after being deformed.

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

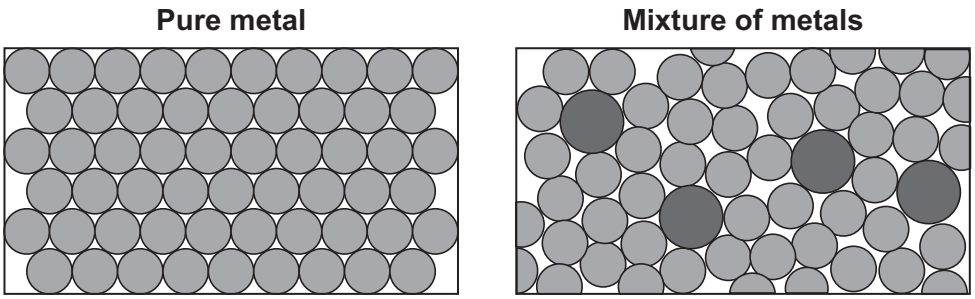
**[1 mark]**

Nitinol is a shape memory

| |
|---|
| alloy. |
| catalyst. |
| polymer. |

**2 (b)** **Figure 2** shows the arrangement of atoms in a pure metal and in a mixture of metals.

**Figure 2**




The mixture of metals is harder than the pure metal.

Use **Figure 2** to explain why.

**[2 marks]**

.....

.....

.....

.....

Do not write outside the box

**2 (c)** Gold and stainless steel are also used for dental braces.

Suggest **two** factors to consider when choosing which metal to use for dental braces.

**[2 marks]**

.....

.....

.....

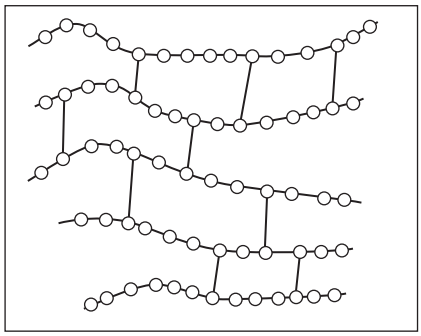
.....

**2 (d)** A thermosetting polymer is used to hold dental braces on the teeth.

**Figure 3** shows the structure of a thermosetting polymer.

**Figure 3**

**Thermosetting polymer**



How can you tell from **Figure 3** that the polymer is thermosetting?

**[1 mark]**

.....

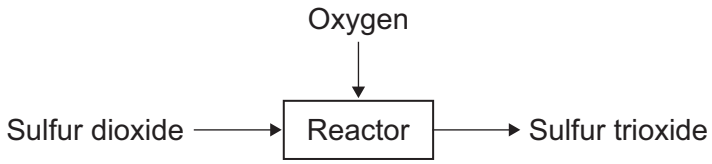
.....

6

Do not write outside the box

**3** **Figure 4** represents the reaction of sulfur dioxide with oxygen.

**Figure 4**




**3 (a) (i)** Complete the word equation for the reaction of sulfur dioxide with oxygen.

**[1 mark]**

sulfur dioxide + ..... ⟶ .....

**3 (a) (ii)** Draw a ring around the correct answer to complete the sentence.

**[1 mark]**

Sulfur dioxide ($SO_2$) is

- a compound.
- an element.
- a mixture.

**3 (b)** The reactants are gases.

When the pressure of the gases is increased, the reaction gets faster.

Complete the sentence.

**[1 mark]**

When the pressure of the gases is increased,

the frequency of the collisions ..... .

Do not write outside the box

**3 (c)** The particles need energy to react.

Complete the sentence.

**[1 mark]**

The minimum amount of energy that particles need to react is called

the ..... energy.

**3 (d)** Give **one** way of increasing the rate of the reaction other than changing the pressure.

**[1 mark]**

.....

.....

5

**Turn over for the next question**

Do not write outside the box

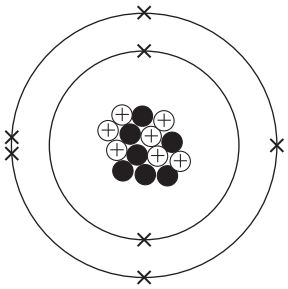
**4** Fertilisers contain elements that plants need.

**AQAGROW**
Plant Fertiliser

Contains:
- Nitrogen
- Phosphorus
- Potassium

**4 (a)** **Figure 5** represents a nitrogen atom.

**Figure 5**



Complete each sentence.

**4 (a) (i)** The mass number of this nitrogen atom is ..... .

**[1 mark]**

**4 (a) (ii)** Atoms of nitrogen with different numbers of neutrons are called ..... .

**[1 mark]**

**4 (a) (iii)** Compared with a proton, the mass of an electron is ..... .

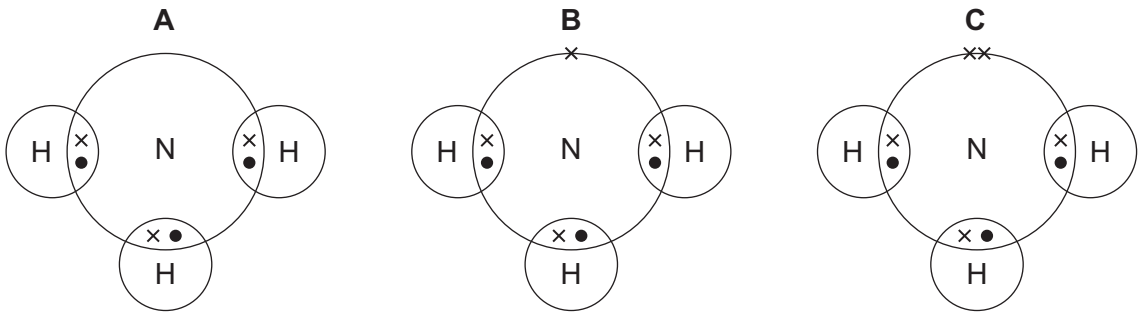
**[1 mark]**

Do not write outside the box

**4 (b)** Fertilisers can be made from ammonia.

**4 (b) (i)** Which diagram, **A**, **B**, or **C**, represents the electronic structure of an ammonia molecule?

**[1 mark]**




The electronic structure of an ammonia molecule is shown in diagram ☐

**4 (b) (ii)** What is the correct formula of ammonia?

Draw a ring around the correct answer.

**[1 mark]**

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

**Question 4 continues on the next page**

Do not write outside the box

**4 (c)** A student made ammonium nitrate by reacting ammonia solution with an acid.

**4 (c) (i)** Name the acid used to make ammonium nitrate.

**[1 mark]**

.....

**4 (c) (ii)** Complete the sentence.

**[1 mark]**

The student added a few drops of ....., which changed colour when the ammonia solution had neutralised the acid.

**4 (c) (iii)** The student added charcoal and filtered the mixture.

This produced a colourless solution of ammonium nitrate.

How is solid ammonium nitrate obtained from the solution?

**[1 mark]**

.....

**4 (c) (iv)** A farmer put ammonium nitrate fertiliser onto a field of grass.

Suggest what would happen to the grass.

**[1 mark]**

.....

.....

Do not write outside the box

**4 (d)** Some fertilisers contain potassium chloride.

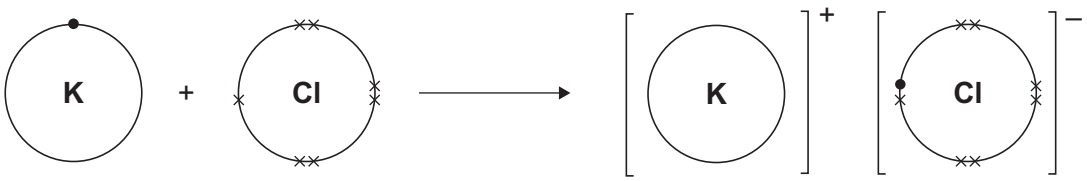
Potassium reacts with chlorine to produce potassium chloride.

**Figure 6** shows how this happens.

The dots (•) and crosses (x) represent electrons.

Only the outer shell is shown.

**Figure 6**




Use **Figure 6** to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with chlorine to produce potassium chloride.

**[4 marks]**

.....

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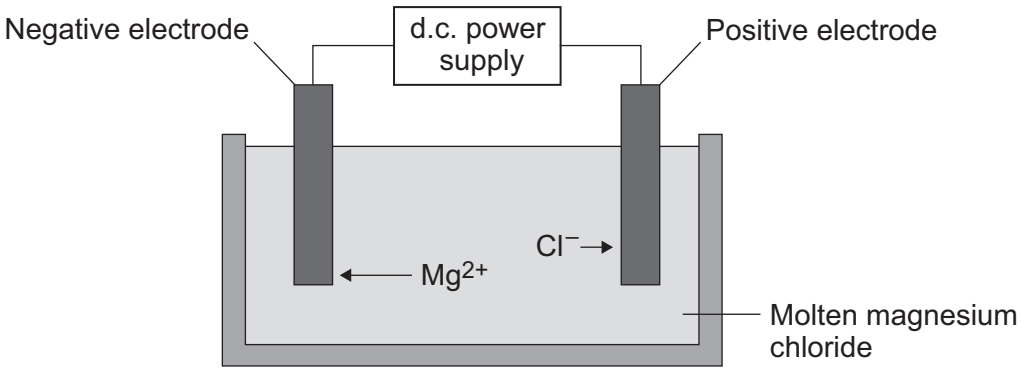
13

Do not write outside the box

**5** Some students investigated reactions to produce magnesium.

**5 (a)** The students used electrolysis to produce magnesium from magnesium chloride, as shown in **Figure 7**.

**Figure 7**




**5 (a) (i)** Magnesium chloride contains magnesium ions and chloride ions.

Why does solid magnesium chloride **not** conduct electricity?

**[1 mark]**

.....

.....

**5 (a) (ii)** One of the products of the electrolysis of molten magnesium chloride is magnesium.

Name the other product.

**[1 mark]**

.....

**5 (a) (iii)** Why do magnesium ions ($Mg^{2+}$) move to the negative electrode?

**[1 mark]**

.....

.....

Do not write outside the box

**5 (a) (iv)** At the negative electrode, the magnesium ions ($Mg^{2+}$) gain electrons to become magnesium atoms.

How many electrons does each magnesium ion gain?

**[1 mark]**

.....

**5 (b)** The students did the experiment four times and weighed the magnesium produced.

**Table 1** shows their results.

**Table 1**

| Experiment | Mass of magnesium produced in grams |
|---|---|
| 1 | 1.13 |
| 2 | 0.63 |
| 3 | 1.11 |
| 4 | 1.09 |

**5 (b) (i)** There is an anomalous result.

Suggest **one** possible reason for the anomalous result.

**[1 mark]**

.....

.....

**5 (b) (ii)** Calculate the mean mass of magnesium produced, taking account of the anomalous result.

**[2 marks]**

.....

.....

.....

Mean mass = ..... g

**Turn over ▶**

Do not write outside the box

**5 (c)** The formula of magnesium chloride is $MgCl_2$

The relative formula mass of magnesium chloride is 95.

The relative atomic mass of magnesium is 24.

**5 (c) (i)** Use the equation to calculate the percentage mass of magnesium in magnesium chloride.

$$\text{Percentage mass of magnesium} = \frac{\text{mass of magnesium}}{\text{mass of magnesium chloride}} \times 100\%$$

**[2 marks]**

.....

.....

.....

Percentage mass of magnesium in magnesium chloride = ..... %

**5 (c) (ii)** Draw a ring around the relative mass of chlorine in $MgCl_2$

**[1 mark]**

**71** **95** **119**

Do not write outside the box

**5 (d)** Magnesium is also produced from the reaction of magnesium oxide with silicon.

**5 (d) (i)** The equation for the reaction is:

$$2\ MgO(s) + Si(s) \rightleftharpoons SiO_2(s) + 2\ Mg(s)$$

What is the meaning of this symbol $\rightleftharpoons$ ?

Draw a ring around the correct answer.

**[1 mark]**

**neutralisation reaction** **precipitation reaction** **reversible reaction**

**5 (d) (ii)** The forward reaction is endothermic.

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

**[1 mark]**

In an endothermic reaction the temperature of the surroundings

decreases.

increases.

stays the same.

12

**Turn over for the next question**

Do not write outside the box

**6** The label shows the ingredients in a drink called Cola.

**Cola**

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

**6 (a) (i)** The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

**[1 mark]**

.....

**6 (a) (ii)** Which ion causes the pH to be 2.9?

**[1 mark]**

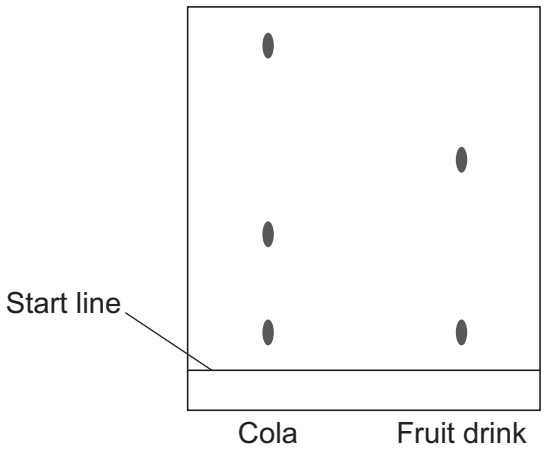
.....

Do not write outside the box

**6 (b)** A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in **Figure 8** shows the student's results.

**Figure 8**




**6 (b) (i)** Complete the sentence.

The start line should be drawn with a ruler and ..... .

Give a reason for your answer.

**[2 marks]**

.....

.....

**6 (b) (ii)** Suggest **three** conclusions you can make from the student's results.

**[3 marks]**

.....

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.....

**Turn over ▶**

Do not write outside the box

**6 (c)** Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

**[1 mark]**

.....

.....

**6 (d)** Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

**6 (d) (i)** Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

**[1 mark]**

| **Question** | **Tick (✓)** |
|---|---|
| Should caffeine be an ingredient in drinks? | |
| Is there caffeine in a certain brand of drink? | |
| How much caffeine should people drink? | |

**6 (d) (ii)** Give **two** reasons why the other questions **cannot** be answered by science alone.

**[2 marks]**

Reason 1 .....

.....

Reason 2 .....

.....

11

Do not write outside the box

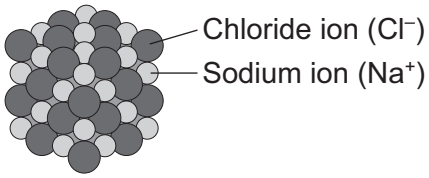
**7** **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Explain why chlorine ($Cl_2$) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

**Chlorine**

Cl — Cl

**Sodium chloride**




Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

**[6 marks]**

.....

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Extra space .....

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6

**END OF QUESTIONS**

*Do not write outside the box*

**There are no questions printed on this page**

**DO NOT WRITE ON THIS PAGE**
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# GCSE
# ADDITIONAL SCIENCE / CHEMISTRY

CH2FP
Mark scheme

4408 / 4402
June 2014

Version: 1.0 Final

STEMUP.CO.UK

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

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 from aqa.org.uk

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## 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 Assessment Objectives and specification content that each question is intended to cover.

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 and underlining

**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 bullet points 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.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 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.

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

| Student | Response | Marks awarded |
|---|---|---|
| 1 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | 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, 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 or by each stage of a longer calculation.

### 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.

### 3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

**Quality of Written Communication and levels marking**

In Question 7 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: Basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: Clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: Detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **1(a)(i)** | high | | 1 | 1 / 2.2.3a | A |
| **1(a)(ii)** | hundred | | 1 | 1 / 2.2.6a | A |
| **1(b)** | hard | | 1 | 1 / 2.2.3b | A |
| **1(c)(i)** | carbon | | 1 | 1 / 2.2.3a | A |
| **1(c)(ii)** | four | | 1 | 1 / 2.2.3b | A |
| **1(c)(iii)** | covalent | | 1 | 1 / 2.2.3a/b | A |
| **1(c)(iv)** | all | | 1 | 1 / 2.2.3a | A |
| **Total** | | | **7** | | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **2(a)** | alloy | | 1 | 1 / 2.2.4d | A |
| **2(b)** | in mixture:<br>*different sized / bigger atoms*<br>*so there are no layers / rows / lines (to slide)* | accept converse | <br>1<br>1 | 1 / 2.2.4c / 2.1.1h | E |
| **2(c)** | any **two** from:<br>• cost<br>• toxicity<br>• strength<br>• *appearance of brace*<br>• *unreactive **or** resistant to corrosion / saliva* | *ignore references to bend and mould*<br><br><br><br><br>*allow rusting as alternative to corrosion* | 2 | 3 / 2.2.4 | E |
| **2(d)** | crosslinks | *allow lines / bonds between the rows / chains* | 1 | 1 / 2.2.5b | E |
| **Total** | | | **6** | | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **3(a)(i)** | oxygen, sulfur trioxide | both needed for mark | 1 | 2 / 2.4 | E |
| **3(a)(ii)** | compound | | 1 | 2 / 2.1.1a | A |
| **3(b)** | increases | *accept (goes) higher / (goes) up / (is) faster) / (are) more frequent* | 1 | 1 / 2.4.1d | G |
| **3(c)** | activation | | 1 | 1 / 2.4.1b | G |
| **3(d)** | catalyst **or** increase temperature | | 1 | 3 / 2.4.1h | E |
| **Total** | | | **5** | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **4(a)(i)** | 14 | | 1 | 2 / 2.3.1c | G |
| **4(a)(ii)** | isotope | | 1 | 1 / 2.3.1d | G |
| **4(a)(iii)** | (very) small | *accept smaller / tiny / (very) little* | 1 | 1 / 2.3.1b | G |
| **4(b)(i)** | C | | 1 | 1 / 2.1 | A |
| **4(b)(ii)** | $NH_3$ | | 1 | 1 / 2.1.1g | A |
| **4(c)(i)** | nitric (acid) | | 1 | 1 / 2.6.2b | G |
| **4(c)(ii)** | indicator | | 1 | 1 / 2.6.1b | E |
| **4(c)(iii)** | crystallisation **or** evaporation | allow by heating **or** cooling **or** leave (on windowsill)<br>*do not accept freezing* | 1 | 1 / 2.6.1c | E |
| **4(c)(iv)** | any **one** from:<br>• grass grows faster<br>• grass grows taller **or** thicker | *allow grass grows better / greener* | 1 | 3 / 2.6.2c | E |
| **4(d)** | potassium (atom) loses (an electron)<br>chlorine (atom) gains (an electron)<br>1 (electron)<br>electron | reference to incorrect bonding or particle = max **3**<br>ignore references to full outer shells | 1<br>1<br>1<br>1 | 1 + 2 / 2.1.1c/d/e | E |
| **Total** | | | **13** | | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **5(a)(i)** | ions cannot move | *allow only conducts as a liquid* | 1 | 1 / 2.7.1a | E |
| **5(a)(ii)** | chlorine | | 1 | 2 / 2.7.1b | G |
| **5(a)(iii)** | they are positively / oppositely charged<br>**or**<br>they are attracted | | 1 | 1 / 2.7.1c | E |
| **5(a)(iv)** | 2 | | 1 | 2 / 2.7.1e | G |
| **5(b)(i)** | any **one** from:<br>• not all the magnesium was collected<br>• *used less time **or** lower current **or** different battery / power pack **or** different balance **or** lower voltage*<br>• error in reading balance<br>• error in recording result | *allow some magnesium was lost* | 1 | 3 / 2.7.1 | E |
| **5(b)(ii)** | 1.11 | correct answer with or without working gains **2** marks.<br>if answer incorrect, allow **1** mark for 0.99<br>**or** for 1.13+1.11+1.09 | 2 | 2 + 3 / 2.7.1 | E |
| **5(c)(i)** | *25 – 25.3* | correct answer with or without working gains **2** marks.<br>If answer incorrect, allow **1** mark for 24/95 | 2 | 2 / 2.3.3a | E |
| **5(c)(ii)** | 71 | | 1 | 2 / 2.3.1f | A |
| **5(d)(i)** | reversible reaction | | 1 | 1 / 2.3.3f | A |
| **5(d)(ii)** | decreases | | 1 | 1 / 2.5.1c | A |
| **Total** | | | **12** | | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **6(a)(i)** | (phosphoric) acid | *allow phosphoric* | 1 | 2 / 2.6.2d | G |
| **6(a)(ii)** | $H^+$ / hydrogen (ion) | *if ion symbol given, charge must be correct* | 1 | 2 / 2.6.2d | E |
| **6(b)(i)** | pencil<br>so it will not run / smudge / *dissolve*<br>**or**<br>because ink would run / smudge / *dissolve* | <br>*ignore pencil will not interfere with / affect the results*<br><br>*ignore ink will interfere with / affect the results* | 1<br>1 | 2 / 2.3.2b | E |
| **6(b)(ii)** | any **three** from:<br>• *3* colours in Cola<br>• *2* colours in Fruit drink<br>• one of the colours is the same<br>• two of the colours in Cola are different<br>• one of the colours in Fruit drink is different<br>• *one of the colours in Cola is the most soluble* | *reference to spots / dots = max **2***<br>*allow colouring for colour*<br>*allow more colours in cola **or** fewer colours in fruit drink*<br>*allow some of the colours in the drinks are different*<br>*accept one of the colours in Cola has the highest $R_f$ value* | 3 | 3 / 2.3.2b | E |
| **6(c)** | different substances travel at different speeds **or** have different retention times | *accept different attraction to solid*<br>*ignore properties of compounds* | 1 | 1 / 2.3.2c | E |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **6(d)(i)** | Is there caffeine in a certain brand of drink? | | 1 | 3 / 2.3.2 | A |
| **6(d)(ii)** | any **two** from:<br>• cannot be done by experiment<br>• based on opinion / *lifestyle choice*<br>• ethical, *social* or economic issue | *accept caffeine has different effects on different people* | 2 | 3 / 2.3.2 | E |
| **Total** | | | **11** | | |



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|

**7** Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content | *There is a statement about the bonding and/or structure **or** melting / boiling point of chlorine **or** sodium chloride.* | *There are statements about the bonding and/or structure of chlorine **or** sodium chloride.* | *There are statements about the bonding and/or structure of chlorine **and** sodium chloride.*<br>*There is an explanation of why chlorine is a gas **or** sodium chloride is a solid.* |

**Examples of chemistry points made in response:**

**Chlorine:**

covalent bonds between atoms

forming (simple) molecules

*no / weak attraction / bonds between molecules*

low boiling point

**Sodium chloride:**

*ionic bonds **or** electrostatic attraction*

strong bonds

in all directions

between oppositely charged ions

forming giant lattice

*large amounts of energy needed to break bonds*

*high melting point*

1 + 2 / 2.1.1f/g 2.2.1a 2.2.2a

E

| Total | | | 6 |
|---|---|---|---|



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| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

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

General Certificate of Secondary Education
Foundation Tier
June 2013

# Additional Science
**Unit Chemistry C2**

**CH2FP**

**F**

# Chemistry
**Unit Chemistry C2**

**Monday 20 May 2013 1.30 pm to 2.30 pm**

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

You may use a calculator.

**Time allowed**
- 1 hour

**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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 6(b) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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



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

**1** This question is about lithium and sodium.

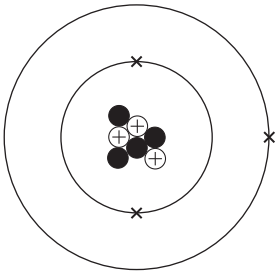
**1 (a)** Use the Chemistry Data Sheet to help you to answer this question.

In which group of the periodic table are lithium and sodium? Group ☐

*(1 mark)*

**1 (b)** A lithium atom can be represented as $^{7}_{3}Li$

The diagram represents the lithium atom.



**1 (b) (i)** Some particles in the nucleus have a positive charge.

What is the name of these particles? .....

*(1 mark)*

**1 (b) (ii)** Some particles in the nucleus have no charge.

What is the name of these particles? .....

*(1 mark)*

**1 (b) (iii)** Use the correct answer from the box to complete the sentence.

| **3** | **4** | **7** |
|---|---|---|

The mass number of this atom of lithium is ☐

*(1 mark)*

**Question 1 continues on the next page**

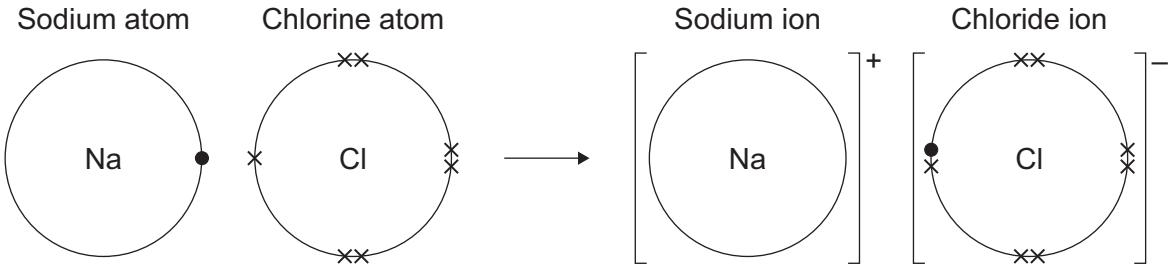
Do not write outside the box

**1 (c)** Sodium reacts with chlorine to produce sodium chloride.

sodium + chlorine ⟶ sodium chloride

The diagram shows how the reaction happens.

Only the outer electrons are shown.




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

**1 (c) (i)** A sodium atom changes into a sodium ion by [gaining / losing / sharing] an electron.

*(1 mark)*

**1 (c) (ii)** A sodium ion has [a negative / no / a positive] charge.

*(1 mark)*

**1 (c) (iii)** The ions in sodium chloride are held together by strong [covalent / electrostatic / magnetic] forces.

*(1 mark)*

Do not write outside the box

**1 (d)** Sodium chloride is an ionic compound.

Tick (✓) **two** properties of ionic compounds.

| Property | Tick (✓) |
|---|---|
| Do **not** dissolve in water | |
| High melting points | |
| Low boiling points | |
| Strong bonds | |

*(2 marks)*

**1 (e) (i)** The formula of sodium chloride is NaCl

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

.....

.....

Relative formula mass = .....

*(1 mark)*

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

The relative formula mass of a substance, in grams, is one [ion / isotope / mole] of the substance.

*(1 mark)*

**1 (f)** Nanoparticles of sodium chloride (salt) are used to flavour crisps.

What are nanoparticles?

.....

.....

*(1 mark)*

**12**

**Turn over ▶**

Do not write outside the box

**2** This question is about salts of ammonia and salts of lead.

**2 (a)** Ammonia dissolves in water to make an alkaline solution.

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

The pH of a solution of ammonia is

2.

7.

11.

*(1 mark)*

**2 (b)** Ammonia can be reacted with an acid to produce the salt ammonium nitrate.

**2 (b) (i)** Name the acid used to produce ammonium nitrate.

.....

*(1 mark)*

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

The reaction of ammonia with an acid is a

neutralisation

polymerisation

reduction

reaction.

*(1 mark)*

**2 (c)** Why do farmers use ammonium nitrate on their fields?

.....

.....

*(1 mark)*

Do not write outside the box

**2 (d)** Lead iodide is a salt that can be produced without using an acid.

**2 (d) (i)** Lead iodide is produced by mixing two solutions.

Complete the word equation.

lead ..... + potassium ..... ⟶ lead iodide + potassium nitrate

*(2 marks)*

**2 (d) (ii)** The lead iodide is produced as a solid.

Complete the sentence.

A solid that is produced when two solutions are mixed is called a ..... .

*(1 mark)*

**2 (d) (iii)** How could the solid lead iodide be separated from the solution?

.....

*(1 mark)*

**2 (d) (iv)** A student mixed two solutions to make sodium chloride.

The equation for the reaction the student used is:

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

How could the student obtain solid sodium chloride from the solution?

.....

*(1 mark)*

9

**Turn over for the next question**

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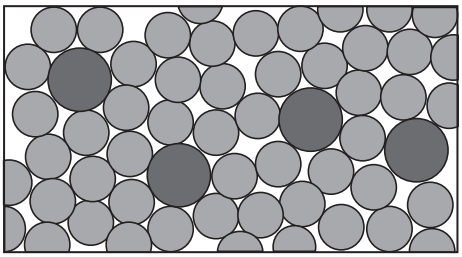
**3** Oil rigs are used to drill for crude oil.



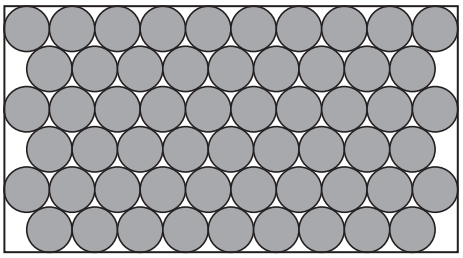
**3 (a)** Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.

**Alloy**



**Pure iron**



Use the diagrams to explain why the alloy is harder than pure iron.

.....

.....

.....

.....

*(2 marks)*

**3 (b)** Drill heads contain diamonds.

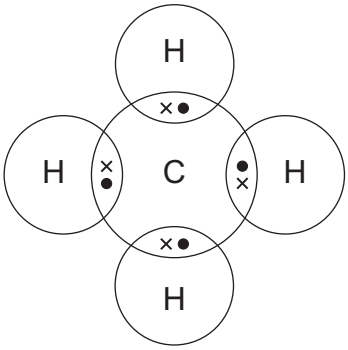
Tick (✓) **two** reasons why diamonds are hard.

| Reason | Tick (✓) |
|---|---|
| Diamonds have a giant covalent structure. | |
| Diamonds have high melting points. | |
| Diamonds are unreactive. | |
| Diamonds have strong bonds between carbon atoms. | |

*(2 marks)*

Do not write outside the box

**3 (c)** Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.




**3 (c) (i)** Draw a ring around the correct answer to complete the sentence.

Methane is

- a compound.
- an element.
- a mixture.

*(1 mark)*

**3 (c) (ii)** Draw a ring around the correct answer to complete the sentence.

The formula of methane is

- $C_4H_4$
- $C_4H$
- $CH_4$

*(1 mark)*

**3 (c) (iii)** Name the type of bond between the carbon and hydrogen atoms in methane.

.....

*(1 mark)*

**3 (d)** Explain why methane is a gas at 20 °C.

.....

.....

.....

.....

*(2 marks)*

9

**Turn over ▶**

Do not write outside the box

**4** Humphrey Davy was a professor of chemistry.

In 1807 Humphrey Davy did an electrolysis experiment to produce potassium.

**4 (a) (i)** Humphrey Davy was the first person to produce potassium.

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

Humphrey Davy's experiment to produce this new element was quickly accepted by

other scientists because he

| |
|---|
| had a lot of money. |
| had a lot of staff to help. |
| was well qualified. |

*(1 mark)*

**4 (a) (ii)** Other scientists were able to repeat Davy's experiment.

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

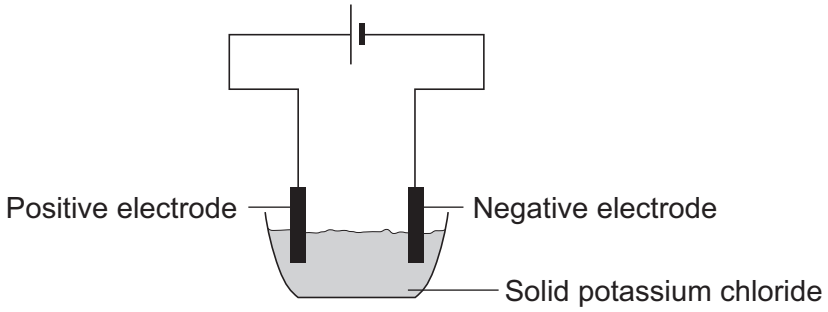
Being able to repeat Davy's experiment is important because

other scientists can

| |
|---|
| check the results of the experiment. |
| see if the experiment is safe. |
| take the credit for the discovery. |

*(1 mark)*

**4 (b)** A student tried to electrolyse potassium chloride.




Potassium chloride contains potassium ions ($K^+$) and chloride ions ($Cl^-$).

Do not write outside the box

**4 (b) (i)** The student found that solid potassium chloride does not conduct electricity.

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

| | | |
|---|---|---|
| **are too big** | **cannot move** | **have no charge** |

Solid potassium chloride does not conduct electricity because

the ions ..... .

*(1 mark)*

**4 (b) (ii)** What could the student do to the potassium chloride to make it conduct electricity?

.....

*(1 mark)*

**4 (b) (iii)** During electrolysis why do potassium ions move to the negative electrode?

.....

*(1 mark)*

**4 (b) (iv)** Draw a ring around the correct answer to complete the sentence.

When the potassium ions reach the negative electrode

they turn into potassium

atoms.

electrodes.

molecules.

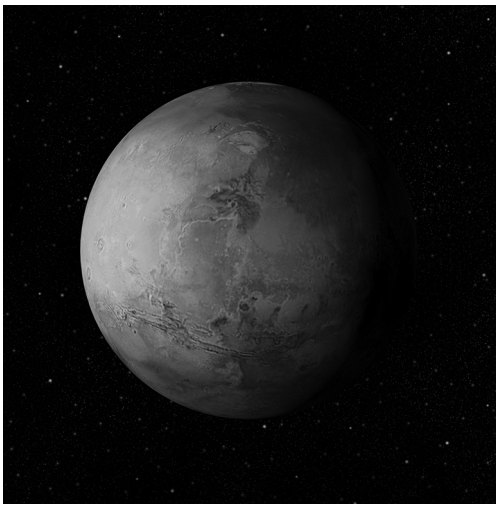
*(1 mark)*

6

**Turn over for the next question**

Do not write outside the box

**5** This question is about the planet Mars.



**5 (a)** Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

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

Ionic compounds are made of

- giant lattices.
- polymer chains.
- simple molecules.

*(1 mark)*

**5 (b)** Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

**5 (b) (i)** Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

Suggest how the polymers could be made to return to their original shape.

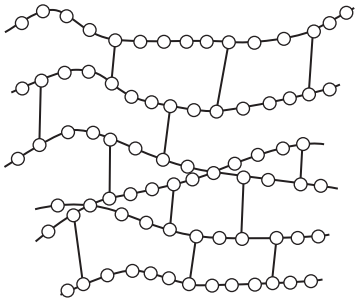
.....

*(1 mark)*

Do not write outside the box

**5 (b) (ii)** Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

*(2 marks)*

**5 (c)** Instrumental methods such as GC–MS are used to analyse substances found on Mars.

In GC–MS, gas chromatography columns are linked to mass spectrometers.

**5 (c) (i)** What does gas chromatography do to the substances?

.....

.....

*(1 mark)*

**5 (c) (ii)** Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

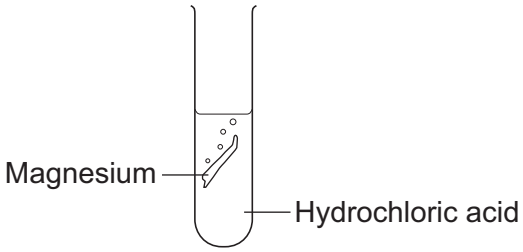
.....

*(2 marks)*

7

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**6** A student investigated the reaction between magnesium and hydrochloric acid.




The equation for the reaction is:

| Mg(s) | + | 2 HCl(aq) | ⟶ | $MgCl_2$(aq) | + | $H_2$(g) |
|---|---|---|---|---|---|---|
| magnesium | | hydrochloric acid | | magnesium chloride | | hydrogen |

**6 (a)** Give **two** observations the student could make during the reaction.

1 .....

.....

2 .....

.....

*(2 marks)*

**6 (b)** *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

- describe how you would carry out the investigation and make it a fair test
- describe the measurements you would make.

.....

.....

.....

.....

.....

.....

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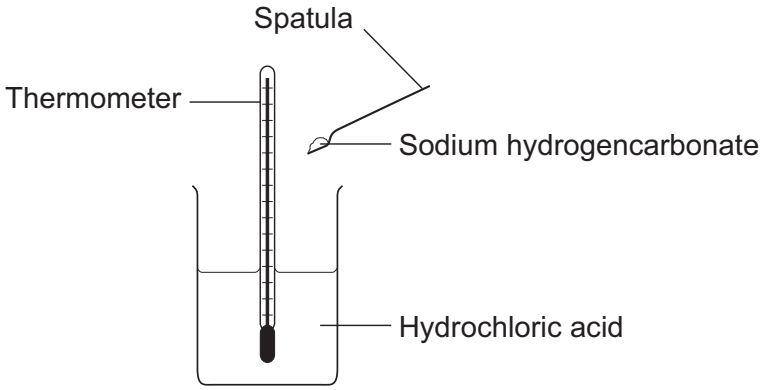
*(6 marks)*

8

**Turn over ▶**

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**7 (a)** Some students did an experiment to find the temperature change when hydrochloric acid reacts with sodium hydrogencarbonate.




The results are in the table.

| Number of spatula measures of sodium hydrogencarbonate | Start temperature in °C | Final temperature in °C | Change in temperature in °C |
|---|---|---|---|
| **2** | 20 | 16 | 4 |
| **4** | 20 | 14 | 6 |
| **6** | 19 | 11 | 8 |
| **8** | 20 | 10 | 10 |
| **10** | 19 | 9 | 10 |
| **12** | 20 | 10 | 10 |

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**7 (a) (i)** Describe, as fully as you can, the trends shown in the students' results.

.....

.....

.....

.....

.....

.....

.....

.....

*(3 marks)*

**7 (a) (ii)** State the type of energy transfer for this reaction.

.....

.....

*(1 mark)*

**Question 7 continues on the next page**

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**7 (b)** Sodium hydrogencarbonate is used as baking powder for making cakes.

When the cake mixture is baked the sodium hydrogencarbonate decomposes.

The equation for the reaction is:

$$2\,NaHCO_3(s) \xrightarrow{\text{Heat}} Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

**7 (b) (i)** The cake mixture rises when baked.



Use the equation to suggest why.

.....

.....

*(1 mark)*

**7 (b) (ii)** The same reaction can be reversed to produce sodium hydrogencarbonate from sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2\,NaHCO_3$$

Do the reactants need to be heated?

Give a reason for your answer.

.....

.....

*(1 mark)*

Do not write outside the box

**7 (c) (i)** Calculate the relative formula mass of sodium hydrogencarbonate ($NaHCO_3$).

Relative atomic masses ($A_r$): H=1; C=12; O=16; Na=23

.....

.....

.....

Relative formula mass ($M_r$) = .....

*(2 marks)*

**7 (c) (ii)** Calculate the percentage by mass of carbon in sodium hydrogencarbonate.

.....

.....

Percentage of carbon = ..... %

*(1 mark)*

9

**END OF QUESTIONS**

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Version 1.0



**General Certificate of Secondary Education**
**June 2013**

# Additional Science / Chemistry CH2FP

# (Specification 4408 / 4402)

# Unit 2: Chemistry 2

# Final

# *Mark Scheme*

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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

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## 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 bullet points 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 / ; e.g. 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.

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

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


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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, 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 or by each stage of a longer calculation.

### 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.

### 3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.


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**Quality of Written Communication and levels marking**

In Question 6(b) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.


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**Question 1**

| question | answers | extra information | Mark |
|---|---|---|---|
| **1(a)** | 1 / one | | 1 |
| **1(b)(i)** | protons | | 1 |
| **1(b)(ii)** | neutrons | | 1 |
| **1(b)(iii)** | 7 | | 1 |
| **1(c)(i)** | losing | | 1 |
| **1(c)(ii)** | a positive | | 1 |
| **1(c)(iii)** | electrostatic | | 1 |
| **1(d)** | high melting points<br>strong bonds | | 1<br>1 |
| **1(e)(i)** | 58.5 | | 1 |
| **1(e)(ii)** | mole | | 1 |
| **1(f)** | very small (particles) **or**<br>1-100nm in size **or**<br>(particle with a) few hundred atoms | ignore tiny / small / smaller / microscopic etc. | 1 |
| **Total** | | | **12** |


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**Question 2**

| question | answers | extra information | Mark |
|---|---|---|---|
| **2(a)** | 11 | | 1 |
| **2(b)(i)** | nitric | | 1 |
| **2(b)(ii)** | neutralisation | | 1 |
| **2(c)** | fertiliser | accept helps plants grow<br>accept provide nitrogen | 1 |
| **2(d)(i)** | nitrate<br>iodide | must be in this order | 1<br>1 |
| **2(d)(ii)** | precipitate | | 1 |
| **2(d)(iii)** | filtration/filtering | | 1 |
| **2(d)(iv)** | crystallisation | allow evaporation / heat / cooling<br>do **not** accept freezing<br>ignore “leave it” if unqualified | 1 |
| **Total** | | | **9** |


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**Question 3**

| question | answers | extra information | Mark |
|---|---|---|---|
| **3(a)** | (alloy) atoms / ions / particles not in layers | accept layers are distorted<br>accept different (size) particles / atoms | 1 |
| | so, (alloy) layers / atoms / ions / particles can't slide | if no other mark awarded allow (an alloy) is a mixture of metals for **1** mark | 1 |
| **3(b)** | diamonds have a giant covalent structure | | 1 |
| | diamonds have strong bonds between carbon atoms | | 1 |
| **3(c)(i)** | a compound | | 1 |
| **3(c)(ii)** | $CH_4$ | | 1 |
| **3(c)(iii)** | covalent | | 1 |
| **3(d)** | methane has a low boiling point or boiling point less than 20°C | | 1 |
| | because it has small molecules | accept it has forces between molecules<br>accept weak forces between molecules for **2** marks | 1 |
| **Total** | | | **9** |



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**Question 4**

| question | answers | extra information | Mark |
|---|---|---|---|
| **4(a)(i)** | was well qualified | | 1 |
| **4(a)(ii)** | check the results of the experiment | | 1 |
| **4(b)(i)** | cannot move | | 1 |
| **4(b)(ii)** | melt it / make it a liquid | allow heat it<br>allow dissolve (in water) / make a solution | 1 |
| **4(b)(iii)** | they are positive | allow opposites attract **or** opposite charges | 1 |
| **4(b)(iv)** | atoms | | 1 |
| **Total** | | | **6** |

**Question 5**

| question | answers | extra information | Mark |
|---|---|---|---|
| **5(a)** | giant lattices | | 1 |
| **5(b)(i)** | heat / warm / increase the temperature | allow reduce pressure<br>do not accept melt | 1 |
| **5(b)(ii)** | (polymer) chains cannot slide<br>because they have cross-links | <br><br>if no other mark awarded allow polymers do not melt for **1** mark | 1<br>1 |
| **5(c)(i)** | separates (substances) | | 1 |
| **5(c)(ii)** | any **two** from:<br>• quick / rapid<br>• accurate<br>• can detect small quantities / sensitive | ignore reliable / precise / efficient<br>ignore references to cost | 2 |
| **Total** | | | **7** |


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**Question 6**

| question | answers | extra information | Mark |
|---|---|---|---|
| **6(a)** | any **two** from:<br>• effervescence / bubbles / fizzing<br>• magnesium disappears / dissolves<br>• heat given off / exothermic<br>• change in pH | <br>allow gas / hydrogen is given off<br>allow volume of gas<br>allow magnesium floats<br>allow change in mass of magnesium<br>allow temperature change<br>do **not** accept temperature decreases<br>do **not** accept pH decreases | 2 |

| **6(b)** | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5. | | 6 |
|---|---|---|---|
| **0 marks** | **Level 1 (1-2 marks)** | **Level 2 (3-4 marks)** | **Level 3 (5-6 marks)** |
| No relevant content. | A simple plan without reference to changing any variable but should include an attempt at measuring rate **or** an attempt at fair testing | A plan including change of concentration / 'volume' of acid **and** should include an attempt at measuring rate **and / or** an attempt at fair testing | A workable plan including change of concentration **and** measurement of rate **and** fair testing |

**examples of chemistry points made in the response could include:**

**Plan:**

- add magnesium to acid
- time reaction / 'count bubbles' / measure volume of gas
- change concentration / 'volume' of acid

**Control Variables:**

- amount / mass / length / same 'size' of magnesium
- volume / amount of acid

| **Total** | | | **8** |
|---|---|---|---|


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**Question 7**

| question | Answers | extra information | Mark |
|---|---|---|---|
| **7(a)(i)** | the more sodium hydrogencarbonate the greater the temperature change<br><br>up to 8 spatula measures<br><br>then the temperature change is constant | accept examples from the table<br><br>accept any correct indication of when change occurs<br><br>if no marks awarded allow **1** mark for:<br>the more sodium hydrogencarbonate the lower the final temperature | 1<br><br>1<br><br>1 |
| **7(a)(ii)** | energy is taken in from the surroundings **or** endothermic | | 1 |
| **7(b)(i)** | gas / carbon dioxide / steam / water is produced | accept carbon dioxide is a gas **or** steam / water is a gas<br><br>allow gas / air expands when heated | 1 |
| **7(b)(ii)** | no, because (reaction) is exothermic<br><br>**or**<br><br>yes, to start the reaction | allow no, because (reactants) were formed by heating<br><br>ignore references to cooling | 1 |
| **7(c)(i)** | 84 | correct answer with or without working gains **2** marks<br><br>if no answer or incorrect answer then evidence of 23 +1 + 12 + (3 × 16) gains **1** mark | 2 |
| **7(c)(ii)** | 14.29 | accept rounding to 14.3 or 14<br><br>allow ecf from (c)(i) | 1 |
| **Total** | | | **9** |

**UMS Conversion Calculator**: www.aqa.org.uk/umsconversion



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| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

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



General Certificate of Secondary Education
Foundation Tier
January 2013

# Additional Science
## Unit Chemistry C2

**CH2FP**

**F**

# Chemistry
## Unit Chemistry C2

**Thursday 24 January 2013 9.00 am to 10.00 am**

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

You may use a calculator.

### Time allowed
- 1 hour

### 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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 8(d) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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



Do not write outside the box

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

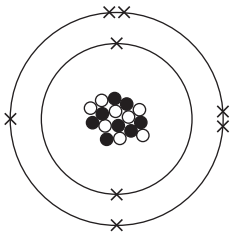
**1** This question is about atoms and molecules.

**1 (a)** Complete the table to show the relative masses of the particles in atoms.

| Name of particle | Relative mass |
|---|---|
| Proton | ..... |
| Neutron | 1 |
| Electron | ..... |

*(2 marks)*

**1 (b)** The diagram shows an oxygen atom.



**Key**
- ● Proton
- ○ Neutron
- × Electron

Use the correct number to complete each sentence.

| | | | |
|---|---|---|---|
| **8** | **16** | **18** | **24** |

The atomic (proton) number of the oxygen atom shown above is ..... .

The mass number of the oxygen atom shown above is ..... .

*(2 marks)*

**1 (c) (i)** Draw a ring around the correct answer to complete the sentence.

Oxygen atoms with different numbers of neutrons are called

isotopes.

molecules.

polymers.

*(1 mark)*

Do not write outside the box

**1 (c) (ii)** An oxygen atom with a different number of neutrons has 10 neutrons.

Draw a ring around the symbol which represents this atom.

$^{16}_{8}O$ $^{18}_{10}O$ $^{18}_{8}O$

*(1 mark)*

**1 (d)** A water molecule contains hydrogen and oxygen atoms.

**1 (d) (i)** Use the correct answer to complete the sentence.

| **a compound** | **an element** | **a mixture** |
|---|---|---|

Water is ..... .

*(1 mark)*

**1 (d) (ii)** Draw a ring around the correct structure of a water molecule.

**H — O — H** **O — H — H** **O — H — O**

*(1 mark)*

**1 (d) (iii)** Draw a ring around the type of bonding in a water molecule.

**covalent** **ionic** **metallic**

*(1 mark)*

**1 (d) (iv)** Draw a ring around the correct answer to complete the sentence.

The bonds in a water molecule are formed by [gaining / losing / sharing] electrons.

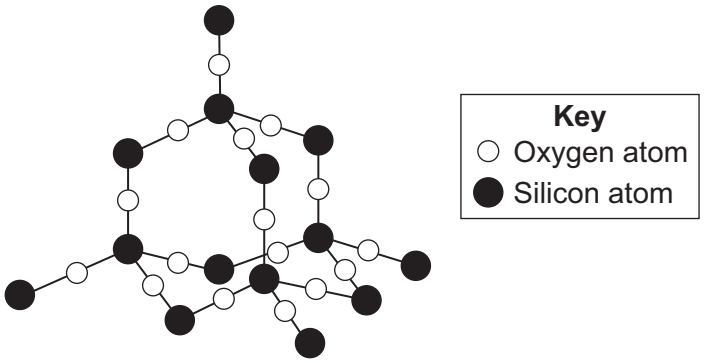
*(1 mark)*

10

**Turn over for the next question**

Do not write outside the box

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




**2 (a)** Use the diagram above to answer the question.

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

In silicon dioxide, each silicon atom is bonded with

two

three

four

oxygen atoms.

The bonds in silicon dioxide are

ionic.

covalent.

metallic.

*(2 marks)*

Do not write outside the box

**2 (b)**



Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

.....

.....

*(1 mark)*

**2 (c)** Nanowires can be made from silicon dioxide.

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

The word 'nano' means the wires are very

| |
|---|
| brittle. |
| thick. |
| thin. |

*(1 mark)*

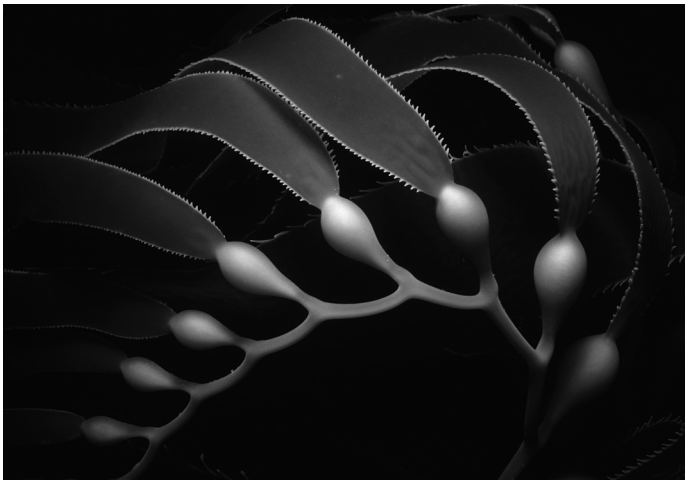
4

**Turn over for the next question**

Do not write outside the box

**3** Kelp is a seaweed.

Kelp can be burned to give out energy.



**3 (a)** Draw a ring around the correct answer to complete the sentence.

Reactions which give out energy are

endothermic.

exothermic.

reversible.

*(1 mark)*

**3 (b)** Which **two** of the following questions **cannot** be answered by scientific experiments alone?

Tick (✓) **two** boxes.

| Question | Tick (✓) |
|---|---|
| How much carbon dioxide is produced when 100 g of kelp is burned? | |
| Does kelp give out more heat energy than coal when burned? | |
| Should people use kelp instead of oil as an energy source? | |
| Will kelp be more popular than coal in the next 10 years? | |

*(2 marks)*

Do not write outside the box

**3 (c)** Potassium iodide can be produced from kelp.

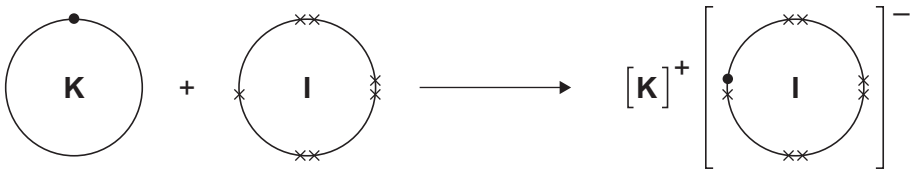
**3 (c) (i)** Potassium can be reacted with iodine to produce potassium iodide.

potassium + iodine → potassium iodide

The diagram shows how this happens.

Only the outer electrons are shown.

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




Use the diagram to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with iodine to produce potassium iodide.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(4 marks)*

**Question 3 continues on the next page**

Do not write outside the box

**3 (c) (ii)** Potassium iodide reacts with lead nitrate.

$$2\,KI(aq) + Pb(NO_3)_2(aq) \rightarrow 2\,KNO_3(aq) + PbI_2(s)$$

Why is this reaction a precipitation?

.....

.....

*(1 mark)*

**3 (c) (iii)** How can the precipitate be removed from the reaction mixture?

.....

.....

*(1 mark)*

9

Do not write outside the box

**4** Thermosoftening polymers can be used to make plastic bottles and food packaging.

**4 (a)** Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

*(1 mark)*

**4 (b)** The reaction to produce the polymers uses a catalyst.

Why are catalysts used in chemical reactions?

.....

.....

*(1 mark)*

**4 (c)** Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

**4 (c) (i)** Name the instrument used to identify the compounds.

.....

.....

*(1 mark)*

**4 (c) (ii)** Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....

.....

*(1 mark)*

**4 (d)** Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

.....

.....

*(2 marks)*

**6**

**Turn over ▶**

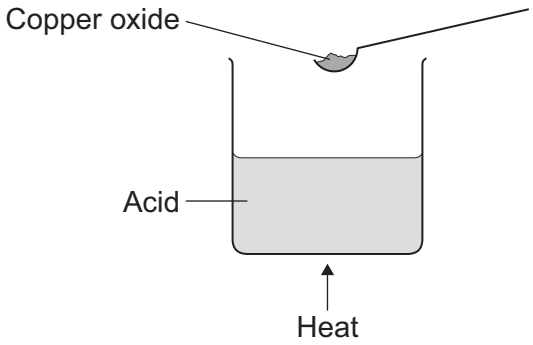
Do not write outside the box

**5** A student added copper oxide to an acid to make copper sulfate.

The student heated the acid.

The student added copper oxide until no more reacted.

**5 (a)** The diagram shows the first stage in the experiment.




**5 (a) (i)** Complete the word equation.

Copper oxide + ..... acid → copper sulfate + water

*(1 mark)*

**5 (a) (ii)** Which **one** of these values could be the pH of the acid?

Draw a ring around the correct answer.

**1** **7** **11**

*(1 mark)*

**5 (a) (iii)** Why is the acid heated?

.....

.....

*(1 mark)*

**5 (b)** After the reaction is complete, some solid copper oxide remains.
Why?

.....

.....

*(1 mark)*

Do not write outside the box

**5 (c)** The student removed the solid copper oxide from the solution.

Suggest what the student should do to the solution to form copper sulfate crystals.

.....

.....

*(1 mark)*

**5 (d)** The mass of copper sulfate crystals was less than the student expected.

Tick (✓) the **one** statement that explains why the mass of copper sulfate crystals was less than expected.

| Statement | Tick (✓) |
|---|---|
| Some copper sulfate may have been lost during the experiment. | |
| The student added too much copper oxide. | |
| The copper sulfate crystals were wet when they were weighed. | |

*(1 mark)*

6

**Turn over for the next question**

Do not write outside the box

**6** Printed pictures can be made using etchings.



An etching can be made when a sheet of brass reacts with iron chloride solution.

**6 (a)** Brass is a mixture of two metals, copper and zinc.

**6 (a) (i)** A mixture of two metals is called ..... .

*(1 mark)*

**6 (a) (ii)** Draw a ring around the correct answer to complete the sentence.

Copper and zinc atoms are different sizes.

This makes brass

| |
|---|
| harder |
| more flexible |
| softer |

than the pure metals.

*(1 mark)*

Do not write outside the box

**6 (b)** Iron chloride has the formula $FeCl_3$

Relative atomic masses ($A_r$): Cl = 35.5; Fe = 56.

**6 (b) (i)** Calculate the relative formula mass ($M_r$) of iron chloride ($FeCl_3$).

.....

.....

.....

Relative formula mass ($M_r$) of iron chloride = .....

*(2 marks)*

**6 (b) (ii)** Calculate the percentage of iron in iron chloride ($FeCl_3$).

.....

.....

.....

Percentage of iron in iron chloride = .....%

*(2 marks)*

6

**Turn over for the next question**

Do not write outside the box

**7** A student investigated the rate of reaction between sodium thiosulfate and dilute hydrochloric acid.

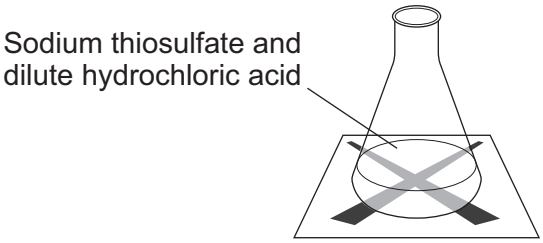
The student placed a conical flask over a cross on a piece of paper.

The student mixed the solutions in the flask.

The solution slowly went cloudy.

The student timed how long it took until the cross could not be seen.






The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

sodium thiosulfate + hydrochloric acid → sodium chloride + water + sulfur dioxide + sulfur

**7 (a)** Explain why the solution goes cloudy.

.....

.....

.....

.....

*(2 marks)*

Do not write outside the box

**7 (b)** The student repeated the experiment with different concentrations of sodium thiosulfate.

| Concentration of sodium thiosulfate in moles per $dm^3$ | Time taken until the cross could not be seen in seconds | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.040 | 71 | 67 | 69 | 69 |
| 0.060 | 42 | 45 | 45 | 44 |
| 0.080 | 31 | 41 | 33 | |

**7 (b) (i)** Calculate the mean time for 0.080 moles per $dm^3$ of sodium thiosulfate.

.....

.....

.....

Mean = ..... seconds

*(2 marks)*

**7 (b) (ii)** Describe and explain, in terms of particles and collisions, the effect that increasing the concentration of sodium thiosulfate has on the rate of the reaction.

.....

.....

.....

.....

.....

.....

*(3 marks)*

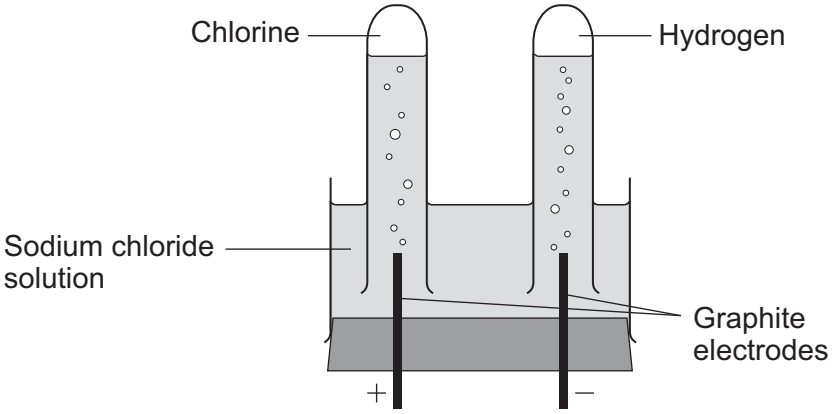
7

**Turn over for the next question**

Do not write outside the box

**8** The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.




**8 (a)** One of the products of the electrolysis of sodium chloride solution is hydrogen.

**8 (a) (i)** Why do hydrogen ions move to the negative electrode?

.....

.....

*(1 mark)*

**8 (a) (ii)** How does a hydrogen ion change into a hydrogen atom?

.....

.....

*(1 mark)*

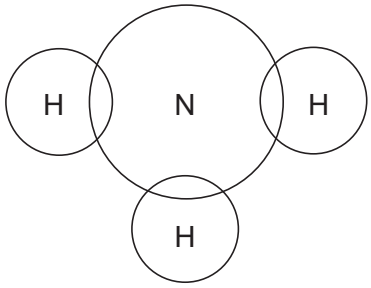
Do not write outside the box

**8 (b)** Hydrogen is used to make ammonia ($NH_3$).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.




*(2 marks)*

**8 (c)** The table shows the ions in sodium chloride solution.

| Positive ions | Negative ions |
|---|---|
| hydrogen | chloride |
| sodium | hydroxide |

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

**8 (c) (i)** Which ion makes the waste alkaline?

.....

*(1 mark)*

**8 (c) (ii)** This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

*(1 mark)*

**Question 8 continues on the next page**

Do not write outside the box

**8 (d)** *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

| | **Mercury cell** | **Membrane cell** |
|---|---|---|
| **Cost of construction** | Expensive | Relatively cheap |
| **Additional substances used** | Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste. | Membrane, which is made of a polymer. The membrane must be replaced every 3 years. |
| **Amount of electricity used for each tonne of chlorine produced in kWh** | 3400 | 2950 |
| **Quality of chlorine produced** | Pure | Needs to be liquefied and distilled to make it pure. |
| **Quality of sodium hydroxide solution produced** | 50% concentration. Steam is used to concentrate the sodium hydroxide solution produced. | 30% concentration. Steam is used to concentrate the sodium hydroxide solution produced. |

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

.....

.....

.....

.....

.....

.....

.....

.....

Do not write outside the box

*(6 marks)*

12

**END OF QUESTIONS**

*Do not write outside the box*

**There are no questions printed on this page**

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**General Certificate of Secondary Education**
**January 2013**

# Science A / Chemistry CH2FP

## (Specification 4405 / 4402)

## Unit 2: Chemistry 2

# Final

# *Mark Scheme*

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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 from: aqa.org.uk

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## 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 bullet points 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.

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

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



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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, 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 or by each stage of a longer calculation.

**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.

**3.8 Ignore / Insufficient / Do <u>not</u> allow**

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.



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# Quality of Written Communication and levels marking

In Question 7(c) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

## Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

## Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

## Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **1(a)** | proton 1<br>electron very small owtte | ignore ±<br>allow zero<br>allow values from 1/1800 to 1/2000 **or** 0.0005 – 0.00055 | 1<br>1 |
| **1(b)** | 8<br>16 | | 1<br>1 |
| **1(c)(i)** | Isotopes | | 1 |
| **1(c)(ii)** | $^{18}_{8}\mathbf{O}$ | | 1 |
| **1(d)(i)** | compound | | 1 |
| **1(d)(ii)** | H-O-H | | 1 |
| **1(d)(iii)** | covalent | | 1 |
| **1(d)(iv)** | sharing | | 1 |
| **Total** | | | **10** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)** | four<br>covalent | | 1<br>1 |
| **2(b)** | because it has a high melting point | accept it won't melt<br>accept it won't decompose or react<br>allow withstand high temperatures<br>ignore boiling point | 1 |
| **2(c)** | thin | | 1 |
| **Total** | | | **4** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)** | exothermic | | 1 |
| **3(b)** | 'Should people use kelp instead of oil as an energy source?'<br>'Will kelp be more popular than coal in the next 10 years?' | | 1<br>1 |
| **3(c)(i)** | any **four** from:<br>• potassium (atom) loses (an electron) and iodine (atom) gains (an electron)<br>• 1 electron<br>• iodide (ion) has negative charge<br>• potassium (ion) has positive charge<br>• electrostatic attraction **or** ionic bonding | If atom or ion omitted = max **3**<br>sharing / covalent / metallic = max **3**<br>ignore reference to full outer shells<br>allow iodine ion<br>accept stable (structure) **or** noble gas (structure) | 4 |
| **3(c)(ii)** | because a solid is formed (from two aqueous solutions) | | 1 |
| **3(c)(iii)** | filtering **or** centrifuging **or** decanting | | 1 |
| **Total** | | | **9** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(a)** | would melt | accept they have a low melting point<br>allow lose their shape<br>ignore would soften when hot<br>ignore boiling point | 1 |
| **4(b)** | to speed up the reaction | accept can use a lower temperature<br>accept less energy needed | 1 |
| **4(c)(i)** | mass spectrometer | allow mass spectroscopy | 1 |
| **4(c)(ii)** | any **one** from:<br>• accurate<br>• sensitive<br>• rapid / quicker<br>• small amount of sample | ignore reliable<br>ignore more precise | 1 |
| **4(d)** | any **two** from:<br>• pressure<br>• temperature<br>• catalyst **or** initiator<br>• solvent | allow concentration | 2 |
| **Total** | | | **6** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)(i)** | sulfuric | | 1 |
| **5(a)(ii)** | 1 | | 1 |
| **5(a)(iii)** | to speed up the reaction | | 1 |
| **5(b)** | because copper oxide in excess<br>**or**<br>because acid all used up / neutralised | allow copper oxide unreacted | 1 |
| **5(c)** | evaporation<br>**or**<br>crystallisation | allow heating<br>allow cooling<br>allow leave (to evaporate)<br>do **not** accept freezing | 1 |
| **5(d)** | Some copper sulfate may have been lost during the experiment | | 1 |
| **Total** | | | **6** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(a)(i)** | an alloy | | 1 |
| **6(a)(ii)** | harder | | 1 |
| **6(b)(i)** | 162.5 | correct answer with or without working gains **2** marks<br>if no answer or incorrect answer then evidence of correct working [56 + (3x35.5)] gains **1** mark | 2 |
| **6(b)(ii)**<br>**(view with 6bi)** | 34.46 | accept rounding from 34 - 34.5<br>correct answer with or without working gains **2** marks<br>accept ecf from 6 (b)(i) correctly calculated for **2** marks<br>if no answer or incorrect answer then evidence of 56 / 162.5 **or** 56 / answer to 6(b)(i) gains **1** mark | 2 |
| **Total** | | | **6** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **7(a)** | because sulfur / S forms<br>which is insoluble / a solid / a precipitate | | 1<br>1 |
| **7(b)(i)** | 32 | correct answer with or without working gains **2** marks<br>accept evidence of 31 + 33 / 2 for **1** mark<br>allow 35 for **1** mark | 2 |
| **7(b)(ii)** | reaction rate increases<br>because of more particles (per unit volume)<br>and because there is an increase in frequency of collisions | if incorrect reference to energy = max **2**<br><br>allow because particles are closer together<br>accept because particles are more likely to collide **or** higher chance of collision<br>ignore more (successful) collisions | 1<br>1<br>1 |
| **Total** | | | **7** |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **8(a)(i)** | because they are positively charged | accept they are positive / $H^+$<br>accept oppositely charged **or** opposites attract<br>ignore they are attracted | 1 |
| **8(a)(ii)** | gains one / an electron | accept $H^+ + e^- \rightarrow H$ or multiples<br>allow gains electrons | 1 |
| **8(b)** | 3 bonding pairs<br>1 lone pair | <br>accept 2 non-bonding electrons on outer shell of nitrogen | 1<br>1 |
| **8(c)(i)** | hydroxide / $OH^-$ | do **not** accept sodium hydroxide | 1 |
| **8(c)(ii)** | $H^+ + OH^- \rightarrow H_2O$ | ignore state symbols<br>ignore word equation | 1 |



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**CH2FP**

| question | answers | extra information | mark |
|---|---|---|---|
| **8(d)** | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5. | | 6 |

| **0 marks** | **Level 1 (1-2 marks)** | **Level 2 (3-4 marks)** | **Level 3 (5-6 marks)** |
|---|---|---|---|
| No relevant content. | There are basic descriptions of advantages or disadvantages of the electrolysis cells. | There are clear descriptions of environmental or economic advantages or disadvantages of the electrolysis cells. Comparisons may be implied. | There are detailed descriptions of environmental and economic advantages and disadvantages, comparing the electrolysis cells. |

**examples of chemistry points made in the response:**

Accept converse where appropriate.

- mercury cell is more expensive to construct
- mercury is recycled but membranes must be replaced
- mercury is toxic but membrane / polymer is not
- removing traces of mercury from waste is expensive
- mercury cell uses more electricity
- mercury cell produces chlorine that is purer
- mercury cell produces higher concentration / better quality of sodium hydroxide (solution)

| **Total** | | | **12** |
|---|---|---|---|

**UMS conversion calculator** www.aqa.org.uk/umsconversion



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| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

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

General Certificate of Secondary Education
Foundation Tier
June 2012

# Additional Science CH2FP
## Unit Chemistry C2

# Chemistry F
## Unit Chemistry C2

**Thursday 24 May 2012 9.00 am to 10.00 am**

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

You may use a calculator.

### Time allowed
- 1 hour

### 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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 7(a) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

### 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 symbol equation for the decomposition of hydrogen peroxide is:

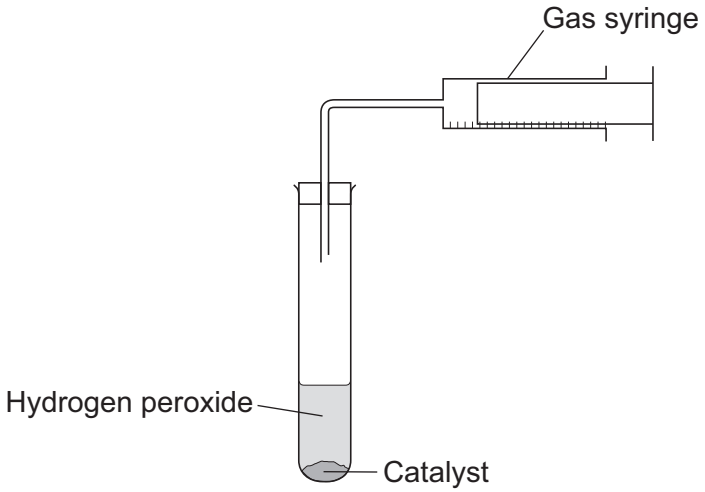
$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

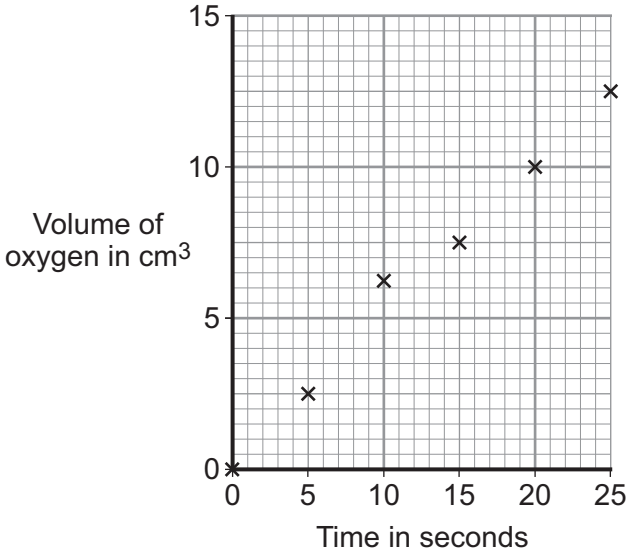
Hydrogen peroxide → ..... + .....

*(1 mark)*

**1 (b)** A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.




**1 (b) (i)** Draw a straight line of best fit to complete the graph.




*(1 mark)*

Do not write outside the box

**1 (b) (ii)** Draw a circle around the anomalous point on the graph.

*(1 mark)*

**1 (b) (iii)** What is the volume of oxygen given off after 15 seconds? ..... $cm^3$

*(1 mark)*

**1 (b) (iv)** How did the volume of oxygen change between 0 and 25 seconds?

.....

*(1 mark)*

**1 (c)** The student wanted to make the reaction faster.

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

**1 (c) (i)** To make the reaction faster, the temperature should be

higher.

lower.

the same.

*(1 mark)*

**1 (c) (ii)** To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

*(1 mark)*

**Question 1 continues on the next page**

Do not write outside the box

**1 (d)** The diagram represents the bonding in oxygen.

O=O

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

**1 (d) (i)** When two oxygen atoms bond, the atoms

share

transfer

delocalise

electrons.

*(1 mark)*

**1 (d) (ii)** The oxygen atoms are joined by

ionic

metallic

covalent

bonds.

*(1 mark)*

**1 (d) (iii)** Oxygen is made of

simple molecules.

a giant lattice.

macromolecules.

*(1 mark)*

**1 (e)** When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

| Statement | Tick (✓) |
|---|---|
| Water has a boiling point of 100 °C. | |
| Water is made of ions. | |
| Water has a melting point lower than room temperature. | |
| Water has a giant covalent structure. | |

*(2 marks)*

12

*Do not write outside the box*

**Turn over for the next question**

**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

Do not write outside the box

**2** Gold and gold ions are used as catalysts.

**2 (a)** An atom of gold is represented as:

$$^{197}_{79}Au$$

Complete the sentences.

The atomic number of gold is ..... .

The number of electrons in an atom of gold is ..... .

*(2 marks)*

**2 (b)** Scientists have found that gold nanoparticles are very good catalysts.

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

A gold nanoparticle contains a few | hundred / thousand / million | atoms.

*(1 mark)*

**2 (c)** The formation of a gold ion ($Au^{3+}$) from a gold atom (Au) is shown in the symbol equation.

$$Au \rightarrow Au^{3+} + 3e^-$$

**2 (c) (i)** Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called ..... .

*(1 mark)*

**2 (c) (ii)** Draw a ring around the correct answer to complete the sentence.

The number of these particles lost when a gold atom becomes a gold ion is | one. / two. / three. |

*(1 mark)*

Do not write outside the box

**2 (d)** Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

.....

*(1 mark)*

**2 (e)** Chloroethene can react to make a thermosoftening polymer.

**2 (e) (i)** Draw a ring around the correct answer to complete the sentence.

When heated, a thermosoftening polymer will

dissolve.

melt.

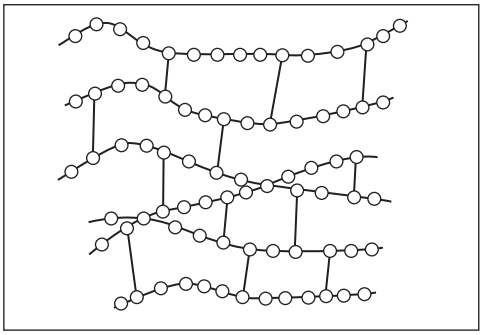
solidify.

*(1 mark)*

**2 (e) (ii)** Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

**Polymer B**



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

.....

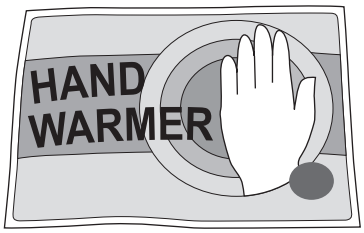
.....

*(1 mark)*

8

Do not write outside the box

**3** Hand warmers use chemical reactions.




**3 (a)** The table shows temperature changes for chemical reactions **A**, **B** and **C**.

| Reaction | Starting temperature in °C | Final temperature in °C | Change in temperature in °C |
|---|---|---|---|
| **A** | 18 | 25 | + 7 |
| **B** | 17 | ..... | + 5 |
| **C** | 18 | 27 | + 9 |

What is the final temperature for reaction **B**? Write your answer in the table.

*(1 mark)*

**3 (b) (i)** What name is given to reactions that heat the surroundings? .....

*(1 mark)*

**3 (b) (ii)** Which reaction, **A**, **B** or **C**, would be best to use in a hand warmer?

Reaction ☐

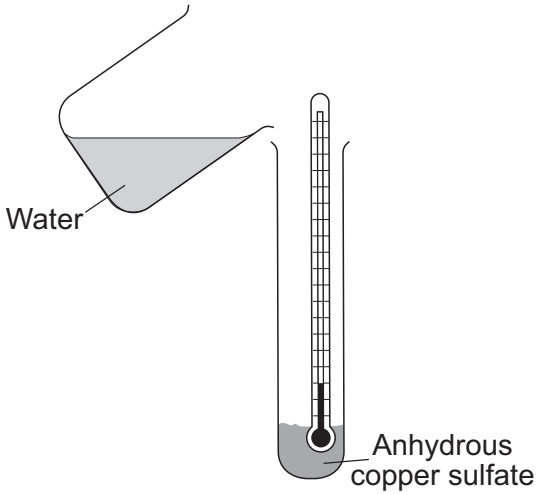
Give a reason why you chose this reaction.

.....

.....

*(2 marks)*

**3 (c)** A student added water to some anhydrous copper sulfate.



Do not write outside the box

The equation for the reaction is shown.

anhydrous copper sulfate + water ⇌ hydrated copper sulfate

$$CuSO_4 + 5\,H_2O \rightleftharpoons CuSO_4.5H_2O$$

The student measured the temperature before and after the reaction.

**3 (c) (i)** The measurements showed that this reaction can be used for a hand warmer.

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

When water is added to anhydrous copper sulfate the temperature

of the mixture

- increases.
- decreases.
- stays the same.

*(1 mark)*

**3 (c) (ii)** Anhydrous copper sulfate is white.

What colour is seen after water is added to the anhydrous copper sulfate?

.....

*(1 mark)*

**3 (c) (iii)** What does the symbol ⇌ mean?

.....

*(1 mark)*

**3 (c) (iv)** The student heated a tube containing hydrated copper sulfate.

Name the solid substance produced.

.....

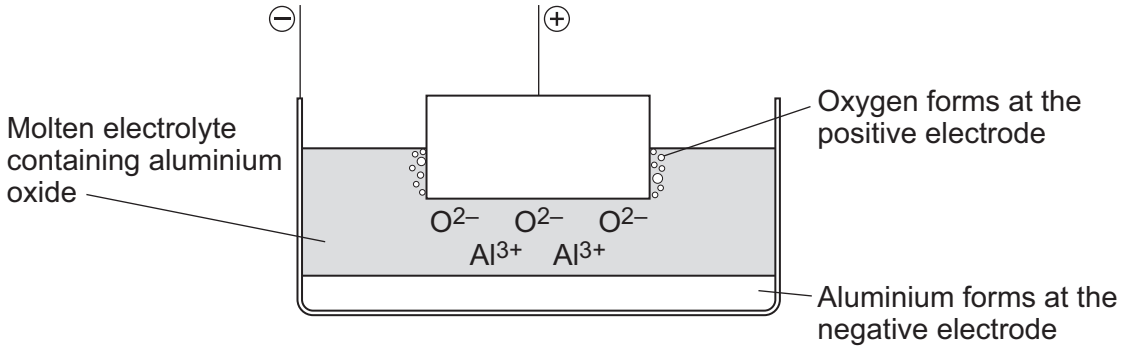
*(1 mark)*

8

**Turn over for the next question**

Do not write outside the box

**4** The diagram represents an electrolysis cell for extracting aluminium.
The current will only flow when the electrolyte is molten.




**4 (a)** The electrolyte is aluminium oxide mixed with another substance.

**4 (a) (i)** What is the name of the other substance in the electrolyte?

Draw a ring around the correct answer.

**cryolite** **rock salt** **limestone**

*(1 mark)*

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

This other substance is added to

| |
|---|
| condense the aluminium oxide. |
| lower the melting point of the aluminium oxide. |
| raise the boiling point of the aluminium oxide. |

*(1 mark)*

**4 (b) (i)** Oxide ions ($O^{2-}$) move to the positive electrode.

Explain why.

.....

.....

.....

.....

*(2 marks)*

Do not write outside the box

**4 (b) (ii)** Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.

$$C + O_2 \rightarrow CO_2$$

Complete the sentence.

The name of the element which reacts with oxygen is ..... .

*(1 mark)*

**4 (b) (iii)** The positive electrode gets smaller.

Suggest why.

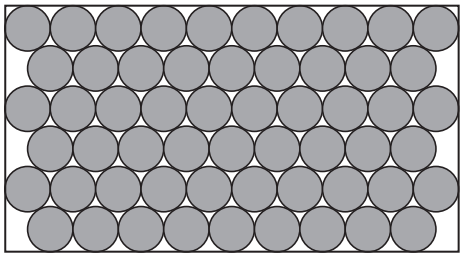
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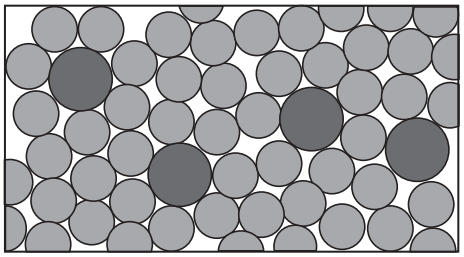
*(1 mark)*

**4 (c)** Aluminium is used in an alloy with magnesium to make drinks cans.

The diagrams show the arrangement of atoms in pure aluminium and in the alloy.



**Pure aluminium**



**Alloy**

The alloy is harder than pure aluminium.

Explain why. Use the diagrams to help you.

.....

.....

.....

.....

*(2 marks)*

8

**Turn over ▶**

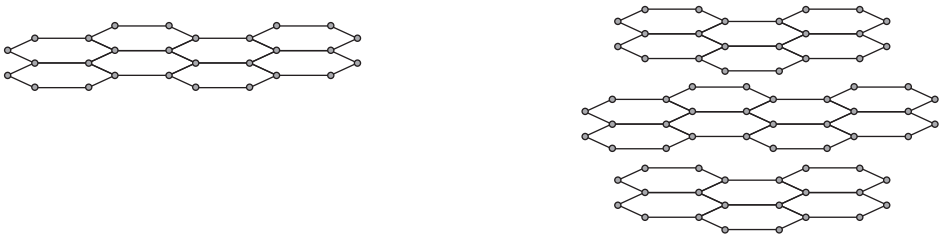
Do not write outside the box

**5** Read the information.

**Graphene**

Scientists have made a new substance called graphene.
The bonding and structure of graphene are similar to graphite.

Graphene is made of a single layer of the same atoms as graphite.



**Graphene** **Graphite**

Use the information above and your knowledge of graphite to answer the questions.

**5 (a)** This part of the question is about graphene.

Choose the correct answer to complete each sentence.

**5 (a) (i)**

| **ionic** | **covalent** | **metallic** |
|---|---|---|

The bonds between the atoms in graphene are ..... .

*(1 mark)*

**5 (a) (ii)**

| **chromium** | **carbon** | **chlorine** |
|---|---|---|

Graphene is made of ..... atoms.

*(1 mark)*

**5 (a) (iii)**

| **2** | **3** | **4** |
|---|---|---|

In graphene each atom bonds to ..... other atoms.

*(1 mark)*

Do not write outside the box

**5 (b)** This part of the question is about graphite.

Graphite is used in pencils.

Explain why. Use the diagrams to help you.

.....

.....

.....

.....

*(2 marks)*

5

**Turn over for the next question**

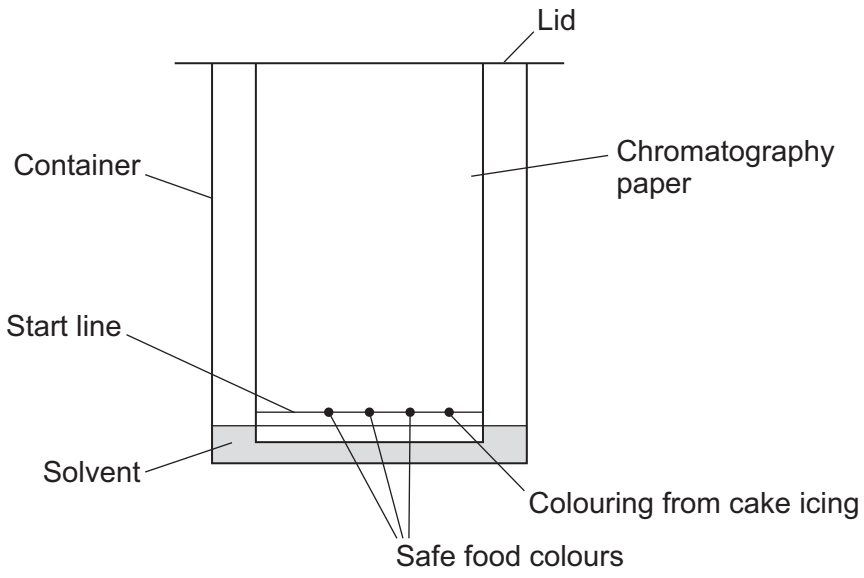
Do not write outside the box

**6** Icing on cakes is tested to check that safe colours were used when they were made.



Paper chromatography is one method of testing which colours are in cake icing.

**6 (a)** The diagram shows an experiment a student did.




**6 (a) (i)** Suggest why there is a lid on the container.

.....

.....

*(1 mark)*

**6 (a) (ii)** The start line should be drawn in pencil **not** in ink.
Suggest why.

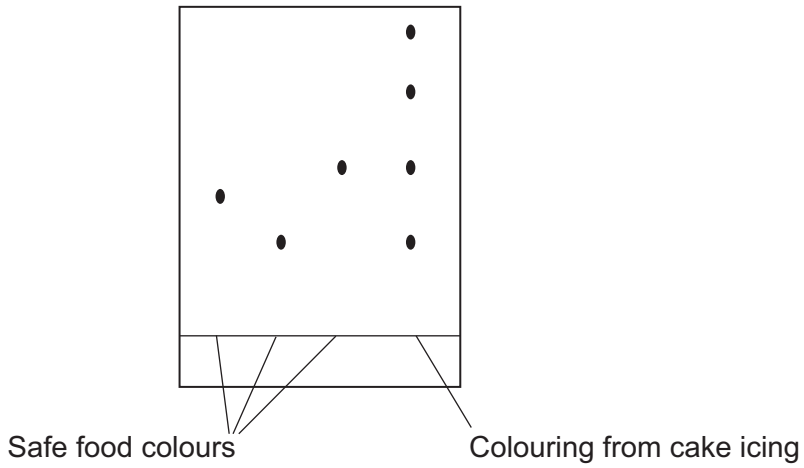
.....

.....

*(1 mark)*

Do not write outside the box

**6 (b)** The diagram shows the results of the paper chromatography experiment.




**6 (b) (i)** How many different food colours were used in the colouring from the cake icing?

.....

*(1 mark)*

**6 (b) (ii)** Is the cake icing safe to eat?

Give a reason for your answer.

.....

.....

*(1 mark)*

**Question 6 continues on the next page**

Do not write outside the box

**6 (c)** Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

**6 (c) (i)** Give **two** advantages of gas chromatography compared with paper chromatography.

.....

.....

.....

.....

*(2 marks)*

**6 (c) (ii)** What does gas chromatography do to the mixture of solvents?

.....

.....

*(1 mark)*

**6 (c) (iii)** What information does mass spectroscopy give?

.....

.....

*(1 mark)*

8

Do not write outside the box

**7 (a)** *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.

potassium hydroxide solution + hydrochloric acid → potassium chloride solution + water

Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

.....

.....

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*(6 marks)*

**Question 7 continues on the next page**

Do not write outside the box

**7 (b)** Ammonium nitrate is another salt.
Ammonium nitrate is made when ammonia solution is neutralised with an acid.

Name the acid to complete the word equation.

ammonia + ..... acid → ammonium nitrate

*(1 mark)*

**7 (c)** Read the information.

## Ammonium nitrate – good or bad?

Some farmers put a lot of ammonium nitrate on their farmland.

Many people are worried about this use of ammonium nitrate.

Rain water can wash the ammonium nitrate off the farmland and into rivers and lakes. The ammonium nitrate may get into drinking water supplies and could be harmful to health.

**7 (c) (i)** Why do some farmers put ammonium nitrate on their farmland?

.....

.....

*(1 mark)*

Do not write outside the box

**7 (c) (ii)** Which **one** of the questions in the table cannot be answered by science alone?

Tick (✓) **one** question.

| Question | Tick (✓) |
|---|---|
| How much ammonium nitrate is in drinking water? | |
| Should farmers stop using ammonium nitrate on their farmland? | |
| Is ammonium nitrate soluble in rain water? | |

Give **two** reasons why this question **cannot** be answered by science alone.

.....

.....

.....

.....

*(3 marks)*

11

**END OF QUESTIONS**

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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Version : 15/08/2012



## General Certificate of Secondary Education

# Additional Science 4408 / Chemistry 4402

## CH2FP Unit Chemistry 2

# Mark Scheme

*2012 examination – June 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 student have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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

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



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

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

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

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

### 3.2 Use of chemical symbols / formulae

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

### 3.3 Marking procedure for calculations

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

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

### 3.4 Interpretation of 'it'

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

### 3.5 Errors carried forward

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

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

### 3.6 Phonetic spelling

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

### 3.7 Brackets

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


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## Quality of Written Communication and levels marking

In Question 7(a) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: Basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: Clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: Detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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**Question 1**

| question | Answers | extra information | mark |
|---|---|---|---|
| **1(a)** | oxygen **and** water | both needed for mark<br><br>allow hydrogen oxide for water<br><br>in any order<br>ignore formulae | 1 |
| **1(b)(i)** | best fit line, omitting point at 10s | straight line drawn through all correct points | 1 |
| **1(b)(ii)** | circle around point at 10 s | allow any indication | 1 |
| **1(b)(iii)** | 7.5 | allow ecf from candidate's line | 1 |
| **1(b)(iv)** | increases (with time) | accept goes from 0 to 12.5 | 1 |
| **1(c)(i)** | higher | | 1 |
| **1(c)(ii)** | more concentrated | | 1 |
| **1(d)(i)** | share | | 1 |
| **1(d)(ii)** | covalent | | 1 |
| **1(d)(iii)** | simple molecules | | 1 |
| **1(e)** | Water has a boiling point of 100°C<br><br>Water has a melting point lower than room temperature | | 1<br><br>1 |
| **Total** | | | **12** |

**……..**



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**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)** | 79<br><br>79 | | 1<br><br>1 |
| **2(b)** | hundred | | 1 |
| **2(c)(i)** | electron(s) | | 1 |
| **2(c)(ii)** | three | | 1 |
| **2(d)** | changes rate of reaction<br><br>**or**<br><br>speeds up / slows down reaction | accept lowers activation energy<br><br><br><br>accept reduces costs | 1 |
| **2(e)(i)** | melt | | 1 |
| **2(e)(ii)** | crosslinking<br>**or**<br>(covalent) bonds between polymers / chains | allow answers on diagram<br><br>allow bonds between layers<br>do **not** allow intermolecular | 1 |
| **Total** | | | **8** |



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**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)** | 22 | | 1 |
| **3(b)(i)** | exothermic | | 1 |
| **3(b)(ii)** | C<br><br>gives out most heat energy | <br><br>accept has largest temperature change / increase<br><br>allow has highest (final) temperature **or** hottest | 1<br><br>1 |
| **3(c)(i)** | increases | | 1 |
| **3(c)(ii)** | blue | ignore pale / dark etc | 1 |
| **3(c)(iii)** | reversible (reaction) | allow goes both ways **or** two / either way | 1 |
| **3(c)(iv)** | <u>anhydrous</u> copper sulfate | | 1 |
| **Total** | | | **8** |



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**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(a)(i)** | cryolite | | 1 |
| **4(a)(ii)** | lower the melting point of the aluminium oxide | | 1 |
| **4(b)(i)** | opposite charges **or** oxide ions are negative<br><br>attract | | 1<br><br>1 |
| **4(b)(ii)** | carbon | | 1 |
| **4(b)(iii)** | reacts with oxygen **or** forms carbon dioxide | accept burns | 1 |
| **4(c)** | **Structure mark**:<br><br>**either** Al (atoms) in layers / rows<br><br>**or** alloy (atoms) not in layers / rows<br><br>**Sliding mark**:<br><br>**either** so (Al layers) can slide<br><br>**or** so (alloy) layers cannot slide | <br><br>accept Al (atoms) all the same size<br>allow Al (atoms) in lines<br><br>accept different sizes of atoms in alloy<br>allow alloy (atoms) not in lines | 1<br><br><br><br><br><br>1 |
| **Total** | | | **8** |



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**Question 5**

| question | answers | extra information | Mark |
|---|---|---|---|
| **5(a)(i)** | covalent | two different answers indicated gains **0** marks | 1 |
| **5(a)(ii)** | carbon | two different answers indicated gains **0** marks | 1 |
| **5(a)(iii)** | 3 | two different answers indicated gains **0** marks | 1 |
| **5(b)** | layers can slide / slip<br><br>because there are no bonds between layers<br><br>**or** so (pieces of) graphite rubs / breaks off<br><br>**or** graphite left on the paper | <br><br>accept because weak forces / bonds between layers | 1<br><br>1 |
| **Total** | | | **5** |



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**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(a)(i)** | prevent evaporation of solvent | allow prevent loss of solvent<br><br>allow to support the (chromatography) paper | 1 |
| **6(a)(ii)** | ink dissolves in the solvent<br><br>**or**<br><br>carbon / graphite does not dissolve in the solvent | allow ink 'runs' / spreads **or** pencil does not 'run' / spread<br>allow ink would affect the result / mixes with colours<br><br>accept pencil for carbon / graphite | 1 |
| **6(b)(i)** | 4 | | 1 |
| **6(b)(ii)** | any **one** from:<br>• because not all colours match<br>• not all colours are safe<br>• some colours could be unsafe<br>• some colours travelled higher (than safe colours) | no mark for 'no / don't know'<br><br>ignore numbers | 1 |
| **6(c)(i)** | any **two** from:<br>• rapid / quick<br>• accurate<br>• sensitive **or** detects very small quantities | ignore reliable / precise<br><br>accept small sample | 2 |

**Question 6 continues on the next page…**



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**Question 6 cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(c)(ii)** | separates | | 1 |
| **6(c)(iii)** | identifies solvents / compounds / substances | accept (relative) molecular mass<br>accept formula mass<br>accept $M_r$<br>accept relative mass<br>accept molecular ion peak | 1 |
| **Total** | | | **8** |



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**Question 7**

| question | answers | extra information | mark |
|---|---|---|---|
| **7(a)** | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 2, and apply a 'best-fit' approach to the marking. | | **6** |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant content. | There is a simple description of a laboratory procedure for obtaining potassium chloride. | There is a clear description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that does not necessarily allow the procedure to be completed successfully by another person. The answer must include the use of an indicator or a method of obtaining crystals. | There is a detailed description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that can be followed by another person. The answer must include the use of an indicator and a method of obtaining crystals |

**examples of the chemistry points made in the response:**

- One reagent in beaker (or similar)
- Add (any named) indicator
- Add other reagent
- Swirl or mix
- Add dropwise near end point
- Stop addition at change of indicator colour
- Note volume of reagent added
- Repeat without indicator, adding same volume of reagent **or** remove indicator using charcoal
- Pour solution into basin / dish
- Heat (using Bunsen burner)
- Leave to crystallise / leave for water to evaporate / boil off water

**Accept** any answers based on titration

**Question 7 continues on the next page . .**



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**Question 7 cont'd..**

| question | answers | extra information | mark |
|---|---|---|---|
| **7(b)** | nitric (acid) | allow $HNO_3$<br><br>ignore incorrect formula | 1 |
| **7(c)(i)** | because it is a fertiliser / helps plants grow | allow plant food<br><br>do **not** accept pesticide / herbicide / neutralising soil | 1 |
| **7(c)(ii)** | tick by: 'Should farmers stop using ammonium nitrate on their land?'<br><br>any **two** from:<br><br>• cannot be done by experiment<br><br>• based on opinion / view<br><br>• ethical **or** economic issue | <br><br><br><br>accept difficult to get / not enough evidence<br><br>allow must be done by survey<br><br><br>if top box ticked allow **1** mark for drinking water varies from place to place | 1<br><br><br>2 |
| **Total** | | | **11** |

**UMS Conversion Calculator** www.aqa.org.uk/umsconversion



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