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# General Certificate of Secondary Education

# Science A 4405 / Chemistry 4402

## CH1HP Unit Chemistry 1

# Mark Scheme

*2012 examination – June series*

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

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

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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.

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.

## Quality of Written Communication and levels marking

In Question 3(b) 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.

**CH1HP**

**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1(a)** | protons (**and**) neutrons | both needed for **1** mark<br><br>ignore p / + and n / 0<br><br>do **not** accept electrons | 1 |
| **1(b)** | because the number of protons is equal to the number of electrons | allow protons and electrons balance / cancel out<br><br>allow positive / + and negative / - balance / cancel out | 1 |
| **1(c)** | because atom A has a full highest energy level **or** full outer shell<br><br>**or** because atom A has a stable arrangement of electrons | it = atom A<br>allow all the shells are full **or** no incomplete shell<br><br>allow because atom A is in Group 0 / a noble gas | 1 |
| **1(d)** | (atom) B / lithium / Li (**and**)<br><br>(atom) C / sodium / Na<br><br>because they have the same number/one outer electron(s) | both needed for **1** mark<br><br><br><br>linked to answer for first mark<br>accept because both need to lose one / an electron<br><br>allow because (atoms) B and C are in Group 1 / the same group / are alkali metals | 1<br><br><br><br>1 |
| **Total** | | | **5** |

**CH1HP**

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)** | any **one** from:<br><br>• there are many stages needed (to extract titanium)<br><br>• more energy / materials are needed (to extract titanium)<br><br>• titanium cannot be extracted by using carbon | ignore references to cost / mining / availability<br><br>allow longer / slower / more complicated process / batch process<br><br>ignore higher temperature<br>ignore reference to electrolysis<br><br>do **not** accept titanium extracted by electrolysis | 1 |
| **2(b)** | carbon dioxide | allow $CO_2$ | 1 |
| **2(c)** | magnesium chloride is electrolysed / used / decomposed<br><br>magnesium and / or chlorine are recycled / reused | <br><br>allow the products of electrolysis are recycled<br>word / symbol equation = **1** mark | 1<br><br>1 |
| **2(d)** | <br><br>because oxygen / nitrogen (in air) would react with the magnesium **or** would produce magnesium oxide / nitride<br><br>whereas argon is inert / unreactive **or** argon does not react (with magnesium) | accept titanium for magnesium<br><br><br><br>ignore argon is in Group 0 / noble gas | <br><br>1<br><br>1 |
| **2(e)** | 240 | | 1 |
| **2(f)** | 250 | allow range 245 to 250 | 1 |
| **Total** | | | **8** |

**CH1HP**

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)(i)** | (1)<br>5<br>3<br>(6)<br>4<br>2 | all numbers in the correct order gains both marks<br>any two numbers in the correct position gains **1** mark | 2 |
| **3(a)(ii)** | water<br>carbon dioxide | ignore formula if correct name given<br>accept hydrogen oxide<br>allow $H_2O$<br>allow $CO_2$<br>accept carbon monoxide / CO **or** carbon / C | 1<br>1 |

**Question 3 continues on the next page . . .**

**CH1HP**

**Question 3 cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(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 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 **basic** description of at least one advantage **or** one disadvantage caused by using plastic shopping bags made from poly(ethene). | There is a **clear** description of both an advantage **and** a disadvantage caused by using plastic shopping bags made from poly(ethene). | There is a **detailed** description of both advantages **and** disadvantages caused by using plastic shopping bags made from poly(ethene). |

**examples of the chemistry/social points made in the response:**
ignore cost unqualified

**Advantages:**

- Simple properties eg strong / low density / water resistant
- Bags can be reused (for shopping) **or** another specified use eg bin liners
- Money charged for bags can go to good causes **or** encourage reuse
- Poly(ethene) bags can be recycled eg made into milk bottle crates
- Poly(ethene) bags can be burned to provide heat for buildings/generation of electricity
- New bags are now made that can biodegrade

**Disadvantages:**

- (Older) bags can take many years to biodegrade
- There is a shortage of landfill space
- Bags are made from (crude) oil which is a non-renewable resource/running out
- Large amounts of energy/fuel are used for the production of poly(ethene)
- Production of poly(ethene) releases carbon dioxide/causes global warming
- Specified issue caused by litter eg visual pollution or effect on wildlife
- Burning bags release carbon dioxide / causes global warming

| Total | | | 10 |
|---|---|---|---|

**CH1HP**

**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(a)** | any **two** from:<br>• carbon dioxide dissolves in water/oceans<br>• marine organisms use (dissolved) carbon dioxide to form their shells/skeletons<br>**or**<br>limestone was formed from the shells/skeleton of marine organisms<br>• plants / algae photosynthesise/ absorb/use carbon dioxide | accept carbon dioxide became locked up in sedimentary rocks/carbonates/limestone<br>**or**<br>precipitation or formation of insoluble carbonates<br>accept remains of plants/algae/ marine organisms contain locked up carbon dioxide/carbon in the form of fossil fuels<br>do **not** accept plants use carbon dioxide for respiration | 2 |
| **4(b)(i)** | because these gases/molecules contain the elements / atoms in amino acids<br>**or** the gases / they contain carbon, hydrogen and nitrogen | ignore oxygen | 1 |

**Question 4 continues on the next page . . .**

**CH1HP**

**Question 4 cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(b)(ii)** | | ignore small-scale / timescale<br><br>ignore references to water/oceans or other theories | |
| | any **two** from: | | 2 |
| | • nobody knows what was in the Earth's early atmosphere | accept these gases / hydrogen / methane / ammonia may not have been in the Earth's early atmosphere<br>accept carbon dioxide / nitrogen may have been in the Earth's early atmosphere<br>accept reference to Venus' present atmosphere<br><br>ignore concentration of gases | |
| | • there may not have been (continuous) lightning | | |
| | • Miller and Urey selected only the gases needed to produce amino acids | | |
| **Total** | | | **5** |

**CH1HP**

**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)(i)** | water | accept hydrogen oxide<br><br>allow $H_2O$ | 1 |
| **5(a)(ii)** | carbon dioxide | allow $CO_2$<br><br>accept any soluble carbonate **or** carbonic acid | 1 |
| **5(b)(i)** | $CaCO_3$ + **2** HCl → $CaCl_2$ + $CO_2$ + $H_2O$ | | 1 |
| **5(b)(ii)** | because sulfur reacts with oxygen / air to produce <u>sulfur dioxide</u> **or** sulfur burns to produce <u>sulfur dioxide</u> | accept correct equation | 1 |
| | and (sulfur dioxide) causes acid rain that reacts with/erodes limestone/calcium carbonate | ignore wears away | 1 |
| **5(c)(i)** | | it = carbon dioxide<br>ignore references to carbon dioxide is in the air | |
| | because carbon dioxide is produced from burning <u>methane</u> | accept correct equation | 1 |
| | because carbon dioxide is produced from <u>decomposing</u> calcium carbonate/limestone | accept correct equation<br>do **not** accept carbon in calcium carbonate reacting with air | 1 |
| **5(c)(ii)** | nitrogen | | 1 |
| | this is the main gas / 75 – 80% / of air | allow there is a lot of this gas in air | 1 |
| **Total** | | | **9** |

**CH1HP**

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6(a)(i)** | olive oil does not dissolve in water | accept olive oil and water are immiscible<br>allow there is no emulsifier<br>ignore mustard<br>ignore do not mix / different densities | 1 |
| **6(a)(ii)** | because mustard is an emulsifier **or** an emulsion forms **or** a suspension of oil in vinegar / water forms **or** vice versa | accept because an emulsifier is added | 1 |
| | the molecules have a 'head' / hydrophilic end which dissolves in / attracted to water | accept a diagram for either or both of these two marking points | 1 |
| | and a 'tail' / hydrophobic end which dissolves in / attracted to oil | if diagram contradicts the description or vice versa max one of these two marks | 1 |
| **6(b)** | (test:) bromine (water) | allow iodine (solution) | 1 |
| | (result:) turns colourless | allow orange colour disappears / decolourises<br>ignore clear | 1 |
| **6(c)** | (olive oil is reacted with) hydrogen | accept hydrogenated | 1 |
| | using a nickel catalyst | | 1 |
| | (at a temperature of about) 60 °C | allow 50 – 120°C<br>ignore hot / heat | 1 |
| **Total** | | | **9** |

**CH1HP**

**Question 7**

| question | answers | extra information | mark |
|---|---|---|---|
| **7(a)** | $C_2H_4$<br><br>a correct other product **and** balanced eg $C_4H_{10}$ | | 1<br><br>1 |
| **7(b)** | bubbling / fizzing / frothing / effervescence | ignore gas given off **or** solution goes cloudy | 1 |
| **7(c)** | any **five** from the following bullet points:<br><br>To gain full marks there should be both advantageous and disadvantageous issues and their importance<br><br>**Advantageous issues using sugar cane:**<br><br>• sugar cane/plants absorb carbon dioxide / photosynthesise<br>• sugar cane / plants are renewable / sustainable<br><br>• low energy process | allow converse for ethanol from crude oil<br><br>ignore costs – unless specified<br>ignore safety<br>ignore simple/low technology process<br>ignore labour intensive as an advantage<br><br>**linked importance**<br><br>so is carbon neutral **or** reduce global warming<br><br>and so save resources / oil **or** crude oil is non-renewable<br><br>and so it saves fuel **or** / making ethanol from crude oil needs fuel for fractional distillation / cracking | 5 |

**Question 7(c) continues on the next page . . .**

**Question 7(c) cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| 7(c) | **Disadvantageous issues using sugar cane:** | ignore fermentation releases carbon dioxide; destruction of habitats/land to build production plants; types of pollution; waste products | |
| | • large areas of land are needed | which leads to destruction of habitats / forest | |
| | • land could be used for food crops | may cause food shortages **or** increases the price of food **or** increasing world population | |
| | • slow process | so limits supply / production of ethanol | |
| | • ethanol is impure **or** contains 50% ethanol | so needs further separation or ethanol from crude oil is 100% pure | |
| | • batch process | so uses more labour | |
| | • the crop yield / supply of ethanol is unreliable | because growth is seasonal / weather dependent **or** possibility of crop failure | |
| | **a justified conclusion** | **compensation mark,** if no other mark awarded allow one mark for two or more issues | |
| **Total** | | | **9** |

**CH1HP**

**Question 8**

| question | answers | extra information | mark |
|---|---|---|---|
| **8(a)** | because the nitrogen from dry air contained noble/Group 0 gases<br><br>**or**<br><br>(because the nitrogen from dry air) contained argon / krypton / xenon<br><br>and three / some of these gases, (argon, krypton, xenon) have a greater density than nitrogen<br><br>**or**<br><br>and argon / krypton / xenon has a greater density than nitrogen | ignore other gases<br><br>ignore helium and neon<br><br>ignore helium and neon | 1<br><br>1 |
| **8(b)(i)** | carbon dioxide would form / is a solid<br><br>**or**<br><br>(solid) carbon dioxide would block pipes | accept carbon dioxide freezes or its freezing point is > –200°C<br><br>ignore melting point | 1 |
| **8(b)(ii)** | helium (**and)** neon | both needed for **1** mark<br><br>accept He and Ne | 1 |
| **8(b)(iii)** | argon (**and)** oxygen<br><br>because there is only a difference of 3 °C in their boiling points | accept Ar and $O_2$<br><br>accept because they have boiling points that are almost the same | 1<br><br>1 |
| **Total** | | | **6** |

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