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## General Certificate of Secondary Education

# Chemistry 4421

## CHY3H Unit Chemistry 3

# Mark Scheme

*2011 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 candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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



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# MARK SCHEME

## Information to Examiners

### 1. General

The mark scheme for each question shows:

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

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

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

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

### 2. Emboldening

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

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

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

### 3. Marking points

#### 3.1 Marking of lists

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

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

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

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

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

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

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

### 3.2 Use of chemical symbols / formulae

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

### 3.3 Marking procedure for calculations

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

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

### 3.4 Interpretation of 'it'

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

### 3.5 Errors carried forward

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

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

### 3.6 Phonetic spelling

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

### 3.7 Brackets

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

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**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1(a)(i)** | Mountain View: (65+35 =)100 | | 1 |
| | Valley Croft: (16+14 =) 30<br><br>**OR**<br><br>Mountain View Ca (65) is about 4 times Valley Croft (Ca 16) (1)<br><br>Mountain View Mg (35) is about twice Valley Croft (Mg 14) (1) | | 1 |
| | | ignore other ions unless used in another calculation or calculations. In this case the list principle applies<br><br>if no other mark awarded either:<br><br>Ca 65 compared with Ca 16 **and** Mg 35 compared with Mg 14 gains **1** mark<br><br>**or**<br><br>difference in Ca (65 – 16) = 49 **and** Mg (35 – 14) = 21 gains **1** mark | |
| **1(a)(ii)** | shake / stir / swirl (water with soap) | allow mix<br>ignore add / use soap / titrate | 1 |
| | (about) 3 × the scum / precipitate / solid (compared with Valley Croft) | accept (about) 3 × volume / drops / amount / quantity of soap solution for (permanent) lather (compared with Valley Croft)<br><br>ignore scale / time | 1 |
| | fair test: eg same volume / amount of water **or** shake for same amount of time **or** use same type / concentration of soap | allow same temperature<br>do **not** accept same volume of soap<br><br>ignore repeat the experiment | 1 |

**Question 1 continues on the next page**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **1(b)** | strong(er) teeth / bones<br><br>**or**<br><br>good for heart | allow contains calcium (ions / compounds)<br><br>ignore magnesium **or** charge on the calcium ion<br>do **not** accept any other ions | 1 |
| **1(c)** | any **one** from:<br><br>• produces scale / limescale / calcium carbonate / magnesium carbonate<br><br>• produces scum<br><br>• more soap needed<br><br>• costs more to soften water<br><br>• (scale) lowers efficiency of appliances | ignore health effects<br><br>allow fur for scale<br><br>allow doesn't lather easily<br>ignore detergent<br><br>allow costs if qualified<br><br>ignore just damage to pipes | 1 |
| **1(d)(i)** | water / everything is made of / contains chemicals<br>**or** water contains named ion from the label | accept company (probably) means water contains no added substances<br>ignore water has not been treated | 1 |
| **1(d)(ii)** | Valley Croft scientists may be biased / vested interest | accept Food Standards Agency / independent scientists (more likely to be) unbiased<br><br>allow Valley Croft scientists may falsify results<br>ignore accuracy / reliability / fairness / validity | 1 |
| **Total** | | | **9** |

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**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)(i)** | (copper) stops barnacles / seaweed (sticking) | it = copper<br><br>accept lead doesn't stop barnacles / seaweed (sticking)<br><br>ignore all other properties | 1 |
| **2(a)(ii)** | (Muntz Metal) is less expensive / cheaper / cheapest | it = Muntz Metal<br><br>must be a comparison<br><br>accept copper is more expensive<br><br>ignore other properties | 1 |
| **2(b)(i)** | atomic absorption spec(troscopy) / spectrometry **or** mass spec(trometry) / spectroscopy | accept spectroscopy / spectrometry alone<br><br>allow AAS / MS<br><br>do **not** allow NMR spectroscopy **or** IR spectrometry **or** chromatography | 1 |
| **2(b)(ii)** | sensitive **or** detect (very) small amounts<br>**or** only small sample needed | it = instrumental method<br>allow (more) precise<br>ignore accurate<br><br>allow converse for chemical method<br>ignore metal contains small amount / low concentration of iron | 1 |
| **2(c)** | any **two** from:<br>• unreactive / not very reactive<br>• strong / hard<br>• malleable / easy to shape | transition elements (= they)<br><br>allow does not corrode<br><br>ignore reference to rust<br><br>ignore tough / durable / hard wearing<br><br>ignore ductile / density / melting point | 2 |
| **Total** | | | **6** |

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**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)** | Group O / 8<br><br>**or** noble / rare / inert gases | accept transition elements / metals<br><br>apply list principle | 1 |
| **3(b)** | (chemically) similar elements (now) in the same group / column | accept iodine has properties of Group 7 / halogens<br>**or** iodine does not have group 6 properties<br>**or** converse for tellurium<br><br>ignore 'it fits the pattern' or any reference to proton / atomic numbers / atomic structure | 1 |
| **3(c)** | any **three** from:<br><br>• (some) boxes had <u>two</u> elements<br><br>• Group 1: copper / silver unreactive (not like the others)<br><br>• there are non-metals and metals in the same group / box<br><br>• Mendeleev left spaces / gaps<br><br>• Medeleev reversed the order (for some elements) | ignore not enough evidence / proof **or** Mendeleev not respected<br><br>allow <u>two</u> correctly identified elements together (in the same box)<br><br>allow copper / silver not alkali metals / Group 1<br><br>accept named examples<br><br>accept (some chemists thought) there were no more elements to discover | 3 |

**Question 3 continues on the next page**

**Question 3 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(d)** | any **two** from:<br><br>• elements arranged in proton / atomic number order<br><br>• group: elements in same group / column have same number of outer electrons<br><br>• elements in same period / row have same number of (electron) shells / energy levels | ignore mass number / atomic weight / neutrons throughout<br><br>allow number of protons / electrons increases across period<br><br>allow number of (electron) shells / energy level increase down group<br><br>allow electron rings<br>allow orbits | 2 |
| **Total** | | | **7** |

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**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(a)** | energy released from making (new) bonds is greater than the energy needed to break (existing) bonds | accept the energy needed to break (existing) bonds is less than the energy released in making (new) bonds<br><br>do **not** accept energy needed to make bonds | 1 |
| **4(b)(i)** | energy / heat of products less than energy of reactants | accept products are lower than reactants<br>**or** reactants higher than products<br><br>accept more energy / heat given out than taken in<br>**or** less energy / heat taken in than given out<br><br>accept energy / heat is given out / lost (to the surroundings)<br><br>allow produce heat<br>ignore produce energy<br><br>accept $\triangle$H is negative<br>**or** energy change / **A** is negative<br>**or B** is less than **C** | 1 |
| **4(b)(ii)** | **B** is (very) high / large | it = **B**<br><br>ignore energy change **C** is high | 1 |
| **4(b)(iii)** | <br>($MnO_2$) catalyst (is added)<br><br>**or** reaction catalysed (by $MnO_2$)<br><br>which lowers activation energy<br><br>**or** which lowers (energy change)<br>**B** | it = $MnO_2$<br><br>accept it is a catalyst<br><br>do **not** accept MgO / magnesium oxide<br><br>accept provides alternative / lower energy pathway<br><br>if hydrogen peroxide is given as a catalyst instead of $MnO_2$ penalise once only in question | <br>1<br><br><br>1 |

**Question 4 continues on the next page**

**Question4 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **4(c)** | any **two** from:<br>• (chemicals) not mixed / stirred<br>• heat / energy lost (from apparatus)<br>• (apparatus) not insulated **or** no lid<br>• low amount / mass / not enough $MnO_2$ **or** low concentration $H_2O_2$<br>• thermometer read incorrectly | <br><br><br><br><br><br><br><br>ignore other experimental error | 2 |
| **Total** | | | **7** |

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**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)(i)** | | incorrect test or no test = **0** mark<br><br>testing the solution **or** using blue litmus = **0** mark | |
| | (test ammonia / gas with red) litmus | accept any acid-base indicator with correct result | 1 |
| | (goes) blue | | 1 |
| | **OR** | | |
| | (conc.) HCl (1) | | |
| | white fumes / smoke / solid (1) | allow white gas / vapour | |
| | **OR** | | |
| | (test ammonia / gas with) Universal Indicator (1) | | |
| | blue / purple (1) | | |
| **5(a)(ii)** | | incorrect test or no test = **0** marks | |
| | add barium chloride / $BaCl_2$ (solution)<br>**or** add barium nitrate / $Ba(NO_3)_2$ (solution) | do **not** accept $H_2SO_4$ added<br><br>allow $Ba^{2+}$ solution / aqueous added | 1 |
| | white precipitate / solid (formed) | allow white barium sulfate / $BaSO_4$<br>ignore barium sulfate / $BaSO_4$ alone | 1 |
| **5(b)(i)** | fully / completely ionised / dissociated<br>**or** hydrogen ions fully dissociated | accept has more ions than weaker acid / alkali of same concentration<br><br>ignore strongly ionised<br><br>do **not** accept ions are fully ionised<br><br>ignore concentrated **or** reference to concentrations of ions | 1 |

**Question 5 continues on the next page**

**Question 5 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **5(b)(ii)** | methyl orange | accept correct spelling only<br><br>accept any strong acid-weak base indicator<br><br>do **not** allow phenolphthalein / litmus / universal indicator | 1 |
| **5(b)(iii)** | 32 × 0.05/1000 **or** 0.0016 (mole $H_2SO_4$)<br><br>(reacts with) 2 × 0.0016 **or** 0.0032 (mole $NH_3$ in 25cm$^3$)<br><br>(0.0032 × 1000/25 =) 0.128 | accept (0.05 x 32) = (V x 25) **or** 0.05 x 32 / 25<br><br>accept dividing rhs by 2 **or** multiplying lhs by 2<br><br>allow ecf from previous stage<br><br>correct answer 0.128 **or** 0.13 with or without working gains all **3** marks | 1<br><br>1<br><br>1 |
| **5(b)(iv)** | 2.176 **or** 2.18<br><br>**or** ecf from candidate's answer to (b)(iii)<br><br>**or** 2.55 if 0.15 moles used | correct answer with or without working<br><br>if answer incorrect or no answer<br><br>0.128 × 17 **or** 0.13 x 17<br><br>**or** their (b)(iii) × 17<br><br>**or** 0.15 × 17 gains **1** mark | 2 |
| **Total** | | | **11** |

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**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(a)(i)** | (brown / red / orange / yellow) goes colourless / decolourised | ignore discoloured / goes clear<br><br>do **not** accept incorrect initial colour | 1 |
| **6(a)(ii)** | (carbon carbon) double bond | accept triple / multiple bonds<br><br>do **not** allow incorrect double bond | 1 |
| **6(b)** | $CO_2$: 6.6/44 **or** 0.15(mole)<br><br>$H_2O$: 2.7/18 **or** 0.15(mole)<br><br>$CH_2$ | <br><br><br><br>ignore multiples | 1<br><br>1<br><br>1 |
| **Total** | | | **5** |

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