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General Certificate of Secondary Education

Chemistry 4421

CHY3H Unit Chemistry 3

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 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	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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Question 1

question	answers	extra information	mark
1(a)		allow magnesium **or** calcium throughout	
	because the water contains magnesium ions **or** magnesium compounds / magnesium sulphate	allow because the water contains magnesium / Mg^{2+} / Mg / Mg^{+} / $MgSO_4$ **do not** accept other ions	1
	sodium carbonate / carbonate <u>ions</u> reacts with the magnesium <u>ions</u> / magnesium sulfate	allow sodium <u>ions</u> exchange / displace / magnesium <u>ions</u>	1
	to form solid / insoluble / precipitate of magnesium carbonate	allow solid contains magnesium (ions) ignore scale / scum	1
1(b)(i)	any **one** from: • anomalous • does not fit the pattern / straight line	ignore error	1
1(b)(ii)	water boils (at 100 °C)	ignore evaporate	1
1(b)(iii)	68 (°C)		1
1(b)(iv)		'it' = solubility	
	solubility goes up then down (after 68 °C **or** ecf from 1(b)(iii))	allow solubility changes direction allow solubility goes down / decreases after 68°C (or ecf from 1(b)(iii))	1
	solubility usually increases as the temperature increases		1
Total			**8**

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Question 2

question	answers	extra information	mark
2(a)	any **two** from: • react with water **or** very reactive • (react with water) releasing gas / hydrogen / fizzing • (react with water) to form an alkaline / hydroxide solution • form ions with a 1+ charge	 allow lose one electron from the outer shell ignore other references to electronic structure ignore physical properties	2
2(b)	any **three** from: • some boxes contain two elements • groups / columns contain elements with different properties • Newlands not a well-known / respected scientist • new idea (not readily accepted by other scientists)	 allow specific examples: Co, Ni **or** Ce, La **or** Di, Mo **or** Ro, Ru **or** Ba, V **or** Pt, Ir allow groups / columns contain both metals and non-metals ignore examples ignore references to sugar factory allow musical scales thought to be silly by some scientists	3

Question 2 continues on the next page . . .

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Question 2 cont'd…

question	answers	extra information	mark
2(c)	one for improvement **and** one for explanation from: • left gaps (for undiscovered elements) (1) • so that elements were in their correct group (1) **or** • did not always follow order of relative atomic weights / masses (1) • so that elements were in their correct group (1)	 allow so the elements fitted the pattern of properties ignore references to atomic number / electronic structure allow so the elements fitted the pattern of properties	2
Total			**7**

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Question 3

question	answers	extra information	mark
3(a)	any **two** from: • do not react with water • do not react with air • malleable • high melting point	 allow unreactive **or** <u>stay</u> shiny **or** do not tarnish **or** do not corrode for either of first two points for **1** mark ignore rusts ignore durable ignore hard / strong ignore boiling point ignore other correct properties	2
3(b)	(transition elements have) same number / two electrons in outer shell / energy level / fourth shell any **one** from: • because lower energy level / inner shell being filled • because third energy level can hold up to eighteen electrons	ignore references to (metallic) structure / bonding	1 1
Total			**4**

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Question 4

question	answers	extra information	mark
4(a)	Hydrogen / H^+	ignore state symbols ignore proton / H	1
4(b)	pH of weak acid is higher than the pH of a strong acid	it = weak acid allow converse for strong acids allow correct numerical comparison	1
	any **one** from: • only partially dissociated (to form ions) • not as many hydrogen ions (in the solution)	allow converse for strong acids allow ionises less allow fewer H^+ released	1
4(c)(i)	(titration of) weak acid <u>and</u> strong base		1
4(c)(ii)	0.61	correct answer with or without working gains **2** marks if the answer is incorrect: moles of sodium hydroxide = (30.5 x 0.5)/1000 = 0.01525 moles **or** (0.5 x 30.5/25) gains **1** mark	2

Question 4 continues on the next page . . .

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Question 4 cont'd..

question	answers	extra information	mark
4(d)	12	correct answer with or without working gains **2** marks or even with incorrect working. if the answer is incorrect: 0.8 x 60 = 48g **or** evidence of dividing 48g (or ecf) by 4 **or** $\frac{0.8 \times 250}{1000} = \frac{0.8}{4} = 0.8 \times 0.25 = 0.2$ mol **or** evidence of multiplying 0.2mol (or ecf) by 60 would gain **1** mark	2
Total			**8**

Question 5

question	answers	extra information	mark
5(a)(i)	(bubble gas produced through) limewater (limewater) goes cloudy / milky	incorrect tests = zero	1 1
5(a)(ii)	red flame indicates that calcium / lithium ions present **or** Ca/Mg also produce a (white) precipitate with NaOH the (white) precipitate formed in test 3 **or** by adding sodium hydroxide solution would dissolve (in excess) if aluminium ions were present	ignore yes or no allow aluminium has no flame colour	1 1
5(a)(iii)	because a white precipitate is formed in test 4 **or** by adding silver nitrate but chloride ions are in hydrochloric acid	ignore yes or no	1 1
5(b)(i)	mass spectrometry **or** atomic absorption spectroscopy	allow MS allow AAS spectrometry / spectroscopy alone is insufficient	1
5(b)(ii)	can detect a small(er) amount of the substance	allow can detect small(er) changes allow small(er) sample sizes ignore references to precision / accuracy	1
Total			**8**

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Question 6

question	answers	extra information	mark
6(a)	all have seven electrons in their outer shell / energy level		1
6(b)	chlorine atom is smaller than bromine atom **or** chlorine atom has fewer shells than bromine atom	must be comparative in all points or converse	1
	outer shell / energy level of chlorine has stronger (electrostatic) attraction to the nucleus than bromine **or** outer shell of chlorine is less shielded from the nucleus than bromine		1
	so chlorine more readily gains an extra electron		1
Total			**4**

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Question 7

question	answers	extra information	mark
7(a)(i)	(-)810	ignore sign correct answer gains **3** marks with or without working if the answer is incorrect look at the working up to a maximum of **two** • bonds broken = (4 x 414) + (2x498) = 2652 kJ • bonds formed = (2x803) + (4x464) = 3462 kJ • correct subtraction of their bonds formed from their bonds broken	3
7(a)(ii)	because energy needed to break the bonds is less than the energy released when bonds are formed		1 1
7(b)	to provide activation energy **or** to break bonds		1
Total			**6**

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