



**General Certificate of Secondary Education**

**Additional Science 4463 /  
Chemistry 4421**

**CHY2H Unit Chemistry 2**

**Mark Scheme**

*2010 examination - January 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.

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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

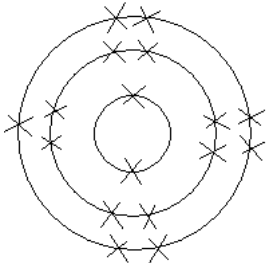
The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

### 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.

## CHY2H

### Question 1

question	answers	extra information	mark
1(a)		<p>accept dots / crosses / e</p> <p>must be drawn on diagram</p> <p>electrons do not need to be paired</p> <p>ignore brackets or + or –charges</p> <p>ignore 2,8,7</p>	1
1(b)	<p>(one) electron</p> <p>lost / given away / transferred from sodium / transferred to chlorine owtte</p>	<p>recognition that electrons are involved</p> <p>must be linked to electrons</p> <p>accept loses electron(s) for <b>2</b> marks</p> <p>NB loses 2 or more electrons gains <b>1</b> mark</p> <p>reference to sharing / covalent max <b>1</b> mark</p> <p>ignore charges on ions formed</p>	1 1
1(c)(i)	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• ions / atoms / they are / it is negatively charged / anions</li> <li>• opposite (charges) attract</li> </ul>	<p>accept they are negative</p> <p>accept they are <u>attracted</u> or it is oppositely charged</p> <p>ignore opposite forces attract</p>	1
1(c)(ii)	hydrogen	<p>accept H<sub>2</sub></p> <p>ignore H or H<sup>+</sup></p>	1

Question 1 continues on next page

**CHY2H****Question 1 continued**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>1(d)(i)</b>	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging  do <b>not</b> accept answers such as global warming / ozone layer etc.  ignore safety unless qualified	1
<b>1(d)(ii)</b>	any <b>one</b> sensible idea eg <ul style="list-style-type: none"> <li>• loss of work / unemployment <b>or</b> company goes out of business</li> <li>• any adverse effect on local economy (owtte)</li> <li>• any adverse effect on paper production / cost of paper / cost of water (treatment)</li> <li>• chlorine (compounds) have been used (for many years) without causing harm owtte</li> <li>• only a tiny amount of chlorine is released so it would not cause harm</li> </ul>	eg shops / house prices etc.  allow less expensive to use chlorine or converse  ignore uses of chlorine to treat drinking water unless qualified	1
<b>1(d)(iii)</b>	ideas related to bias	accept more reliable or valid or fair  ignore more accurate / fair test	1
<b>Total</b>			<b>8</b>

**CHY2H****Question 2**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
2(a)	gas / g	accept low density / low boiling point <b>or</b> weak intermolecular forces <b>or</b> small molecules <b>or</b> simple molecules <b>or</b> simple molecular (structure)  accept volatile <b>or</b> easy to evaporate  ignore very light  ignore incorrect name of gas	1
2(b)	filter / filtration	accept filter paper  accept decant / centrifuge  ignore filter funnel / sieving / drained off / funnelling  ignore names of compounds  ignore evaporation / heating if after filtration  do <b>not</b> accept crystallisation	1
2(c)	evaporation / crystallisation	accept heating / boiling  accept 'leave for a few days' owtte  allow cool  do <b>not</b> allow freeze  ignore filtration	1

**Question 2 continues on next page**

**CHY2H****Question 2 continued**

question	answers	extra information	mark
2(d)	candidates can gain marks from any two of the three linked pairs		
	hydrogen chloride escaped / released (into atmosphere) <b>or</b> (hydrogen chloride) damaged vegetation / harmful	to get both of these <b>2</b> marks hydrogen chloride must be mentioned ignore HCl formed / produced / made	1
	used to make chlorine / bleach		1
	unpleasant smell (of calcium sulfide) <b>or</b> waste of calcium (sulfide)	ignore calcium sulphide alone allow calcium / calcium sulfate for calcium sulphide	1
	converted to sulfur <b>or</b> used to make sulfuric acid	to get both of these 2 marks calcium (sulphide) must be mentioned ignore sale of calcium sulfide	1
	unreacted coal (1)	must be linked to first coal point	
recycled / burnt / used / sold (1)			
<b>Total</b>			<b>7</b>



**CHY2H****Question 3**

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

**Question 3 continues on next page**

**CHY2H****Question 3 contd**

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

**CHY2H****Question 4**

question	answers	extra information	mark
4(a)	any <b>four</b> from: <ul style="list-style-type: none"> <li>• giant structure / lattice</li> <li>• <u>positive</u> ions</li> <li>• sea of electrons <b>or</b> delocalised / free electrons</li> <li>• awareness of <u>outer shell</u> / highest energy level electrons are involved</li> <li>• (electrostatic) attractions / bonds between electrons and <u>positive</u> ions</li> <li>• bonds / attractions (between atoms/ ions) are strong</li> <li>• a lot of energy / heat is needed to break these bonds / attractions</li> </ul>	max <b>3</b> marks if any reference made to covalent / ionic bonding / molecules <b>or</b> intermolecular forces <b>or</b> graphite / diamond <b>or</b> forces of attraction between electrons and then ignore throughout  ignore layers  ignore electrons can move  allow hard to break for strong ignore forces unqualified  ignore high temperature	4

**Question 4 continues on next page**

**CHY2H****Question 4 continued**

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

**CHY2H****Question 5**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
5(a)(i)	0.2	correct answer gains <b>2</b> marks with or without working  accept answer in table  if answer incorrect 5/25 gains <b>1</b> mark	2
5(a)(ii)	any <b>one</b> from: <ul style="list-style-type: none"> <li>wider range of temperatures (owtte)</li> <li>(repeat at the same temperature) to improve accuracy / reliability</li> <li>reveal anomalous results (owtte)</li> <li>so you can get an average / better average</li> </ul>	allow to make it reliable / accurate  allow to eliminate random / human errors / to check results owtte  ignore to make it a fair test / to get better results  ignore precision and validity	1
5(b)	any <b>two</b> from: <ul style="list-style-type: none"> <li>particles gain energy / have more energy</li> <li>particles move faster</li> <li>particles collide more</li> <li>more of the particles have the activation energy <b>or</b> more of the collisions are successful (owtte) <b>or</b> particles <u>collide</u> with more force / harder / more energy</li> </ul>	allow atoms / molecules / they instead of particles throughout  ignore increases particles activation energy  ignore move more / vibrate more  ignore increases / decreases activation energy  allow more successful collisions alone for <b>1</b> mark	2
<b>Total</b>			<b>5</b>

**CHY2H****Question 6**

question	answers	extra information	mark
6(a)	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• heat water / make steam / boil water <b>or</b> heat / steam used in stage 1</li> <li>• carbon dioxide from stage 3 used in stage 7 / to make urea</li> <li>• nitrogen and / or hydrogen recycled (owtte)</li> <li>• ammonia and / or carbon dioxide <u>recycled</u> (owtte)</li> </ul>	<p>allow reused instead of recycled in correct context</p> <p>allow unreacted material / gas recycled from stage 5 (to 4)</p> <p>allow unreacted material / gas recycled from stage 8 ( to 7)</p> <p>NB if neither of the last two points are awarded unreacted material recycled = <b>1</b> mark</p>	2
6(b)	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• fertiliser / fertilise / fertile</li> <li>• provide nitrogen</li> <li>• any idea of faster / better / helps growth of crop</li> <li>• greater yield of crop</li> <li>• helps proteins / amino acids to form in plants owtte</li> </ul>	<p>ignore cost</p> <p>ignore neutralisation / minerals / to treat plants / photosynthesis</p> <p>allow give plants nutrients</p> <p>allow provides nitrate</p>	1
6(c)	3	<p>allow correct multiples</p> <p>eg <math>2\text{CH}_4 + 2\text{H}_2\text{O} \rightarrow 2\text{CO} + 6\text{H}_2</math></p>	1
6(d)(i)	(forward reaction is) exothermic / gives out heat	<p>accept Le Chatelier based answers</p> <p>accept reverse argument eg because at high temperature the ammonia would decompose</p>	1

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

**CHY2H****Question 6 continued**

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

**Question 6 continues on the next page**

**CHY2H****Question 6 continued**

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