



# **General Certificate of Secondary Education**

## **Science A 4405 / Chemistry 4402**

**CH1HP      Unit Chemistry 1**

# **Mark Scheme**

*2012 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 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	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, 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 7(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**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>1(a)</b>	2,4	allow electrons in any position on correct shells	1
<b>1(b)</b>	(electron) 79 neutron 118	allow phonetic spelling	1 1 1
<b>1(c)(i)</b>	16 <b>and</b> 9	in this order	1
<b>1(c)(ii)</b>	any <b>two</b> from: <ul style="list-style-type: none"> <li>• (100% / pure) gold is soft</li> <li>• (alloyed) to make the metal hard(er)</li> <li>• gold is expensive <b>or</b> alloy is less expensive</li> </ul>	ignore reasons about colour / lustre / corrosion / rarity  allow layers can slide in pure gold  ignore just 'the ring is an alloy' allow (alloyed) to stop the layers sliding  allow (alloyed) to make the metal strong	2
<b>Total</b>			<b>7</b>

## CH1HP

## Question 2

question	answers	extra information	mark
2(a)(i)	$C_7H_{16}$	mark answer line first answer may be given in the table	1
2(a)(ii)	$C_nH_{2n+2}$		1
2(b)(i)	carbon monoxide	do <b>not</b> accept carbon oxide do <b>not</b> accept water ignore CO	1
2(b)(ii)	because of partial / incomplete combustion (in reaction 2) <b>or</b> complete combustion (in reaction 1)	allow because there is less/insufficient oxygen (in reaction 2) <b>or</b> sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) <b>or</b> $19O_2$ (in reaction 1) <b>and</b> $13O_2$ (in reaction 2) ignore air	1
2(c)(i)	15 (%)	ignore units	1
2(c)(ii)	water (vapour) / steam	allow $H_2O$ / $OH_2$ / hydrogen oxide	1
2(c)(iii)	<u>sulfur</u> in petrol / crude oil (reacts with oxygen)	it = sulfur dioxide	1
2(c)(iv)	because nitrogen <b>and</b> oxygen (are in the air and) react  at high temperature (inside a petrol engine)	allow nitrogen <b>and</b> oxygen burn accept nitrogen + oxygen → nitrogen oxide <b>or</b> symbol equation ignore air allow heat/hot (engine)	1  1

Question 2 continues on the next page.....

**CH1HP****Question 2 cont'd....**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>2(d)</b>	because carbon dioxide / it causes global warming <b>or</b> because carbon dioxide / it has an impact on oceans	allow because carbon dioxide/it causes greenhouse effect / climate change	1
	because this carbon dioxide / carbon / it was 'locked up' (in fossil fuels) <b>or</b> because the percentage/amount of carbon dioxide/it in the atmosphere is <u>increasing</u>		1
<b>Total</b>			<b>11</b>



## CH1HP

## Question 3

question	answers	extra information	mark
3(a)(i)	6-8	accept any value in the range 6-8	1
3(a)(ii)	<p>any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>there are <u>many</u> earthquakes predicted by scientists each year</li> <li>expense / inconvenience / panic caused by government / people taking action</li> <li>most / some earthquakes do <u>little or no damage</u></li> <li>scientists do not know what is happening <u>below the crust</u></li> <li>scientists cannot (accurately) predict <u>where</u> the earthquake will occur</li> <li>scientists cannot (accurately) predict <u>when</u> the earthquake will occur</li> <li>scientists cannot (accurately) predict the <u>strength</u> of the earthquake</li> </ul>	<p>allow scientists / predictions have been wrong</p> <p>ignore lack of evidence</p> <p>allow earthquakes are random</p> <p>If none of the last 3 points have been awarded then 'scientists cannot accurately predict earthquakes' gains <b>1</b> mark</p>	3
3(b)(i)	<p>continents were once joined together or continents breaking up / separating / fitted like a jigsaw</p> <p>so the continents are <u>moving</u>.</p>	<p>allow crust/plate for continent</p> <p>accept there was a supercontinent / Pangaea</p> <p>accept continents not in fixed positions</p> <p>allow <u>continents move apart</u> for <b>2</b> marks</p> <p>if no other mark awarded allow continents drift apart for <b>1</b> mark</p>	<p>1</p> <p>1</p>

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

**CH1HP****Question 3 cont'd....**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>3(b)(ii)</b>	convection currents (in the mantle)	allow credit for both marking points if given in 3(b)(i)	1
	caused by heat <b>or</b> caused by radioactive processes	accept movement / flow (in the mantle)  ignore chemical reactions	
<b>Total</b>			<b>8</b>

**CH1HP****Question 4**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>4(a)(i)</b>	reduction	accept redox / smelting	1
<b>4(a)(ii)</b>	3 4 3		1
<b>4(b)(i)</b>	55	ignore other units	1
<b>4(b)(ii)</b>	water	accept sodium hydroxide accept correct formulae H <sub>2</sub> O or NaOH	1
<b>4(b)(iii)</b>	any <b>one</b> from: <ul style="list-style-type: none"><li>• save energy / fuel for transporting the ore</li><li>• (old) quarries nearby for waste/red mud</li></ul>	accept less (cost of) transport allow transported quickly	1

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

**CH1HP****Question 4 cont'd...**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>4(c)</b>	<b>Environmental</b> any <b>one</b> from: <ul style="list-style-type: none"><li>• less mining / quarrying (of bauxite)</li><li>• less landfill space needed / used</li><li>• less use of fossil fuels / energy</li><li>• less carbon dioxide produced</li></ul>	allow loss of habitat / less qualified noise pollution  allow less red mud / waste	1
	<b>Ethical or social</b> any <b>one</b> from: <ul style="list-style-type: none"><li>• saves resources</li><li>• creates (local) employment</li><li>• more people aware of the need for recycling</li></ul>	allow using resources more than once  if answers reversed and both correct award <b>1</b> mark allow less qualified noise pollution if not given in environmental	1
<b>Total</b>			<b>7</b>

## CH1HP

## Question 5

question	answers	extra information	mark
5(a)	W the water boils <b>or</b> steam is produced	students do not have to use the letters but the descriptions should be in logical order  allow water vapour rises	1
	X the oils / substances (in lavender) are vaporised / removed (by the steam)		1
	Y (the vapours are) condensed	allow turned back to liquid ignore cooled	1
	Z the water can be run off / tapped off leaving the oil(s)	allow oil floats on water <b>or</b> they form two layers	1
5(b)(i)	add bromine water	incorrect reagent = 0 marks	1
	(bromine water) is decolourised / goes colourless	ignore clear  if colour of bromine water given it must be yellow, orange, red or brown	1
5(b)(ii)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• to harden the oil</li> <li>• to change the oil into a solid</li> <li>• to make the oil into a spread</li> <li>• to increase its melting point</li> </ul>	ignore boiling point	1

Question 5 continues on the next page.....

**CH1HP****Question 5 cont'd...**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>5(b)(iii)</b>	(olive oil is) reacted with hydrogen	incorrect process = max 2	1
	using a <u>nickel</u> catalyst	accept hydrogenated	1
	at a temperature of about 60 °C	allow 50°C to 160°C if last two points not given allow 'heat with a catalyst' for <b>1</b> mark	1
<b>Total</b>			<b>10</b>

**CH1HP****Question 6**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>6(a)</b>	limewater <b>or</b> calcium hydroxide solution		1
	(reacts with carbon dioxide and) turns cloudy / milky	linked to first point if no other mark awarded 'puts out lighted splint' gains <b>1</b> mark	1
<b>6(b)(i)</b>	any <b>two</b> from: <ul style="list-style-type: none"><li>• same volume / amount of the acids</li><li>• concentration of the acids</li><li>• temperature</li><li>• same surface area / size / mass / amount of calcium carbonate</li><li>• same measuring equipment</li></ul>		2

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

**CH1HP****Question 6 cont'd...**

question	answers	extra information	mark
<b>6(b)(ii)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>• (after about 4 minutes) the sulfuric acid stops reacting <b>or</b> nitric acid continues to react</li> <li>• (initially) the reaction with sulfuric acid is faster</li> <li>• (the reaction stops) because calcium sulfate is a solid</li> <li>• (the reaction continues) because calcium nitrate is soluble / in solution / aqueous</li> <li>• because the calcium sulfate prevents the sulfuric acid reacting with the calcium carbonate</li> <li>• (the rate is faster) because sulfuric acid contains two hydrogens</li> </ul>	accept more CO <sub>2</sub> with nitric acid at any time after 4 minutes  allow sulfuric acid produces a solid  allow nitric acid produces an (aqueous) solution	<b>3</b>
<b>Total</b>			<b>7</b>



## CH1HP

## Question 7

question	answers	extra information	mark
7(a)(i)	$C_{11}H_{24}$		1
	it does not have a (carbon carbon) double bond <b>or</b> it has only single (carbon carbon) bonds.	linked to first mark point accept it is an alkane <b>or</b> it is (a) saturated (hydrocarbon)  accept converse statement	1
7(a)(ii)	ethene 4 x single C-H bonds  1 x double C=C bond		1
	ethanol 5 x single C-H bonds  1 x single C-C bond	if additional bonds are given on water molecule then both ethene and ethanol must be correct for <b>1</b> mark	1
7(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 simple description of advantages <b>and / or</b> disadvantages of environmental or economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.  There is a weak or no conclusion.	There a clear description of advantages <b>and / or</b> disadvantages of environmental <b>and</b> economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.  There is a conclusion based on the factors described.	There is a detailed description of the advantages <b>and / or</b> disadvantages of environmental <b>and</b> economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane, considering both processes.  There is a justified conclusion.

examples of the chemistry points made in the response	
<p style="text-align: center;"><b>Sugar cane</b></p> <p><u>Advantage</u></p> <p><b>Environmental:</b></p> <ul style="list-style-type: none"> <li>it is renewable / sustainable</li> <li>it grows absorbing CO<sub>2</sub> which makes it 'carbon neutral'</li> </ul> <p><b>Economical / Social:</b></p> <ul style="list-style-type: none"> <li>growing it is labour intensive so provides (local, rural) employment</li> <li>low amount of energy / fuel needed so process costs are low</li> <li>simple / low technology process so process / investment costs are low</li> </ul> <p><u>Disadvantage</u></p> <p><b>Environmental:</b></p> <ul style="list-style-type: none"> <li>destruction of habitats / biodiversity to provide land to grow sugar cane</li> </ul> <p><b>Economical / Social:</b></p> <ul style="list-style-type: none"> <li>land should be used to grow food (shortage / cost / population increase)</li> <li>growing or process is slow / batch / unreliable (crop failure)</li> </ul>	<p style="text-align: center;"><b>Crude oil</b></p> <p><u>Disadvantage</u></p> <p><b>Environmental:</b></p> <ul style="list-style-type: none"> <li>it is non-renewable / will run out</li> <li>it contains 'locked up' carbon / CO<sub>2</sub> or when released increases global warming</li> <li>destruction of marine habitats caused by accidents / spillages</li> </ul> <p><b>Economical / Social:</b></p> <ul style="list-style-type: none"> <li>process requires small number of trained workers</li> <li>high amount of energy / fuel needed so process costs are high</li> <li>complex / high tech process so process / investment costs are high</li> </ul> <p><u>Advantage</u></p> <p><b>Environmental:</b></p> <ul style="list-style-type: none"> <li>does not use land as it is offshore</li> </ul> <p><b>Economical / Social:</b></p> <ul style="list-style-type: none"> <li>no loss of food crops</li> <li>extracting or process is fast / continuous / reliable</li> </ul>
<b>Total</b>	<b>10</b>

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