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General Certificate of Secondary Education
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Science A / Chemistry CH1HP

(Specification 4405 / 4402)

Unit 1: Chemistry 1

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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.

Further copies of this Mark Scheme are available from: aqa.org.uk

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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 bullet points 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 / ; e.g. 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	green, 5	0
2	red*, 5	1
3	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, 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 or by each stage of a longer calculation.

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.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 3(b) candidates 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.

Candidates 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.

Question 1

question	answers	extra information	Mark
1(a)(i)	2.8.3	any sensible symbol can be used to represent an electron	1
1(a)(ii)	proton(s) **and** neutron(s)	both needed for the mark	1
1(a)(iii)	number of protons is equal to number of electrons	allow positive and negative charges cancel out allow same amount of protons and electrons	1
1(b)(i)	**2** Al + Fe_2O_3 → **2** Fe + Al_2O_3	equation must be balanced	1
1(b)(ii)	aluminium is more reactive (than iron)	it = aluminium accept converse accept aluminium displaces iron accept aluminium is higher in the reactivity series (than iron)	1
Total			**5**

Question 2

question	answers	extra information	Mark
2(a)	any **two** from: • copper / ores are running out / harder to find • there are no / very small amounts of high-grade copper ores left • copper metal is in demand • copper is expensive • now economical to extract copper from low-grade ores	it = copper allow new methods of extraction e.g. bioleaching and phytomining allow high-grade ores are running out for **2** marks	2
2(b)(i)	large amounts / 98% of rock to dispose of as waste **or** waste rock takes up a lot of space	accept contains toxic (metal) compounds / bioleacher	1
2(b)(ii)	(copper sulfide reacts with oxygen to) produce sulfur dioxide / SO_2 that causes acid rain	allow (sulfur reacts with oxygen to) produce sulfur dioxide / SO_2 allow description of effects of acid rain **or** sulfur dioxide if no other mark awarded allow CO_2 produced which causes global warming **or** CO_2 produced by burning fuel or heating the furnace for **1** mark	1 1
2(b)(iii)	any **one** from: • large amounts of fuels / energy used (for the furnace and electrolysis) • (the extraction has) many steps / stages / processes • large amounts of ore / material have to be mined	 allow large amounts of electricity needed ignore high temperature / electrolysis unqualified allow (extraction) is a long process / takes a lot of time allow ores contain a low percentage of copper	1

Question 2 continues on the next page

Question 2 continued

question	answers	extra information	Mark
2(b)(iv)	(copper ions move towards) the negative electrode / *cathode* because copper ions / Cu^{2+} are positively charged **or** are oppositely charged **or** copper ions need to gain electrons	 allow because metal ions are positive **or** opposites attract	1 1
2(b)(v)	(growing) plants		1
Total			**9**

Question 3

question	answers	extra information	Mark
3(a)(i)	exothermic	accept combustion allow burning **or** oxidation **or** redox	1
3(a)(ii)	carbon monoxide / *CO* (is produced) because there is incomplete / partial combustion (of the fuel)	allow monoxide (is produced) ignore carbon oxide accept because there is insufficient oxygen / air (to burn the fuel)	1 1

Question 3(b) continues on the next page

Question 3 continued

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 5.		6

0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There is a statement that crude oil is heated **or** that substances are cooled. However there is little detail and any description may be confused or inaccurate.	There is some description of heating / evaporating crude oil **and either** fractions have different boiling points **or** there is an indication of a temperature difference in the column.	There is a reasonable explanation of how petrol is or fractions are separated from crude oil using evaporating **and** condensing.

If cracking is given as a preliminary or subsequent process to fractional distillation then ignore.

However, if cracking / catalyst is given as part of the process, maximum is **level 2**

examples of chemistry points made in the response could include:

- Some / most of the hydrocarbons (or petrol) evaporate / form vapours or gases
- When some of / a fraction of the hydrocarbons (or petrol) cool to their boiling point they condense
- Hydrocarbons (or petrol) that have (relatively) low boiling points and are collected near the top of the fractionating column or hydrocarbons with (relatively) high boiling points are collected near the bottom of the fractionating column
- The process is fractional distillation
- Heat the crude oil / mixture of hydrocarbons or crude oil / mixture is heated to about 350°C
- Some of the hydrocarbons remain as liquids
- Liquids flow to the bottom of the fractionating column
- Vapours / gases rise up the fractionating column
- Vapours / gases cool as they rise up the fractionating column
- The condensed fraction (or petrol) separates from the vapours / gases and flows out through a pipe
- Some of the hydrocarbons remain as vapours / gases
- Some vapours / gases rise out of the top of the fractionating column
- There is a temperature gradient in the fractionating column or the fractionating column is cool at the top and hot at the bottom

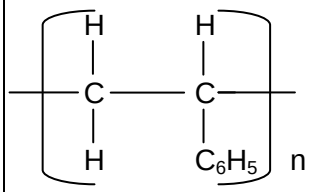
Total			**9**

Question 4

question	Answers	extra information	Mark
4(a)	any **one** advantage from:	ignore can be made into other items	1
	• conserves resources (of crude oil / metal ores)	allow the materials (in the pen) are non-renewable allow less expensive than producing from the raw material	
	• reduces use of landfill	ignore less waste	
	• less use of fuels/energy		
	• less carbon dioxide produced	ignore global warming unqualified	
	any **one** disadvantage from:		1
	• made of different polymers / alloys / materials		
	• difficulty / cost of separating the different materials	allow not all the materials can be recycled	
4(b)	hard / strong / durable		1
	resistant to corrosion **or** unreactive	allow do not rust do **not** allow corrosive	1
4(c)(i)		ignore pressure / hot / heat	
	vapours (of decane)	allow high temperature (≥150 °C)	1
	passed over a catalyst **or** porous pot **or** aluminium oxide	allow catalyst even if incorrectly named	1
	or		
	mixed with steam (1)		
	at a (very) high temperature (1)	if temperature quoted, must be ≥500 °C	

Question 4 continues on the next page

Question 4 continued

question	Answers	extra information	Mark
4(c)(ii)	many monomers **or** many ethene molecules		1
	join / bond **OR** monomers / ethene molecules (1) form chains **or** very large molecules (1)	allow addition polymerisation for second mark if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for **1** mark	1
4(d)		allow bonds that do not extend through brackets 7 single bonds are used and are in the correct places with no additional atoms (1) the brackets and the n are in the correct place (1)	2
Total			**10**

Question 5

question	Answers	extra information	Mark
5(a)(i)	H_2O	must be formula	1
	CaO	must be formula	1
5(a)(ii)		it = carbon (dioxide)	
	carbon dioxide from the air / (Earth's early) atmosphere	accept carbon dioxide from millions of years ago	1
	formed (sedimentary) rocks **or** fossil fuels	ignore trapped / stored	1
5(b)(i)		it = carbon (dioxide)	
	decreases rapidly at first		1
	then slowly **or** levels off		1
		allow both marks if the description is correct using either 'rapidly' **or** 'slowly'	
		allow correct use of figures for either marking point	
		if no other mark awarded, allow CO_2 decreased for **1** mark	
5(b)(ii)	any **two** from: • used by plants • dissolved in oceans • 'locked up' in fossil fuels **or** formed fossil fuels • 'locked up' in rocks **or** formed rocks	it = carbon (dioxide) accept photosynthesis	2

Question 5 continues on the next page

Question 5 continued

question	Answers	extra information	Mark
5(c)		it = percentage of carbon (dioxide)	
	(yes)	ignore yes or no	
	because the percentage of carbon dioxide is increasing		1
	which causes global warming (to increase)	allow (carbon dioxide) causes greenhouse effect/climate change	1
	or		
	(no)		
	because the percentage of carbon dioxide is low (1)		
	compared to millions of years ago (1)	allow global warming can be caused by other factors (e.g. Sun / water vapour / methane)	
Total			**10**

Question 6

question	Answers	extra information	Mark
6(a)	Earth consists of crust, mantle and core		1
	relative positions (of crust, mantle and core) correctly given		1
	crust is thinner than the mantle and core	accept correct information from a labelled diagram	1
6(b)	continents were joined together	accept there was a supercontinent / Pangaea	1
	the continents then drifted apart **or** moved apart	ignore attempts at explanations for movement	1
Total			**5**

Question 7

question	Answers	extra information	Mark
7(a)	ethanol is made up of only one type of molecule **or** ethanol is a compound	allow ethanol is pure	1
	diesel / petrol / rapeseed oil are mixtures	accept composition of diesel / petrol / rapeseed oil varies / changes allow different hydrocarbons have different melting points ignore diesel, petrol and rapeseed oil are impure	1
7(b)(i)	sugar is mixed with / dissolved in water	accept sugar cane for sugar	1
	yeast (is added)	allow enzymes are added if no other mark awarded, allow correct word or chemical equation for **1** mark	1
7(b)(ii)		accept carbon for carbon dioxide	
	(growing sugar cane / rapeseed) plants absorbs carbon dioxide	accept carbon dioxide is used for photosynthesis	1
	which is released (when the biofuel burns)	do **not** accept no carbon dioxide is released (when biofuels burn)	1
7(c)	nitrogen / N_2 **and** oxygen / O_2 (in the air)	do **not** accept fuels contain nitrogen	1
	react in the hot engine / at high temperature		1

Question 7 continues on the next page

Question 7 continued

question	Answers	extra information	Mark
7(d)	any **three** from: • ethanol needs a higher temperature to burn than petrol **or** ethanol has a higher flashpoint than petrol • ethanol releases less energy (per litre) than petrol • sugar is renewable **or** crude oil is non-renewable / will run out • sugar cane growth is unreliable / slow **or** crude oil is a reliable supply • ethanol is made by a batch / slow process **or** petrol is made by a continuous / fast process • ethanol is carbon neutral **or** petrol contains 'locked up' carbon dioxide • sugar / sugar cane should be used for food not for fuels	ignore references to melting point allow ethanol is not readily available **or** petrol is readily available accept idea of food shortages	3
	a justified conclusion that adds value	accept one **additional** point from the list above as long as one comparison of replacing petrol with ethanol is made	1
Total			**12**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion