GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1H

Chemistry Paper 1H

Mark scheme

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2 4 6 G 8 4 6 4 / C / 1 H / M S

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead 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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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 their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

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 do not form the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

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**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

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 errors / 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** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks should be awarded for a correct numerical answer, without any working shown.
Full marks are **not** awarded for a correct final answer from incorrect working.

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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore 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.

3.10 Do <u>not</u> accept

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

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from: • mass of copper produced increased (from 1900 to 2010) • before 1930 the mass of copper produced increased slightly • after 1930 the mass of copper produced increased rapidly • the highest mass of copper was produced in 2010 • the lowest mass of copper was produced in 1900 • the increase in the mass of copper produced was not linear	 allow a value in the range 1925 to 1930 allow a value in the range 1925 to 1930 allow the highest mass of copper produced was 15.8 ($\times 10^9$ kilograms) allow the lowest mass of copper produced was 0.2 ($\times 10^9$ kilograms)	2	AO3 5.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(alloy of copper and zinc is harder because) the atoms are different sizes (so the) layers are distorted (so the) layers cannot easily slide	 allow (so the) atoms cannot slide over each other	1 1 1	AO2 5.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(% copper = 100 – 13.5 =) 86.5 (%)		1	AO2 5.2.2.7
	(mass of copper =) $\frac{86.5}{100}$ × 5.25	allow correct use of an incorrectly determined percentage of copper	1	
	= 4.54125 (g)		1	
	= 4.54 (g)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question	1	
	OR			
	(mass of zinc =) $\frac{13.5}{100}$ × 5.25 (1)			
	= 0.70875 (g) (1)			
	(mass of copper = 5.25 – 0.70875) = 4.54125 (g) (1)	allow correct use of an incorrectly determined mass of zinc		
	= 4.54 (g) (1)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question		

Total Question 1	**9**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	H_2SO_4		1	AO2 5.4.2.2 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	so all the acid reacts	allow so all the acid is used up	1	AO1 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3		ignore references to filtration		AO1 5.1.1.2 5.4.2.3 RPA8
	heat the solution (to remove some of the water)	allow evaporate some of the water / solution	1	
	leave to cool / crystallise		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	all points correctly plotted	allow a tolerance of ± ½ a small square allow **1** mark for 3 or 4 points correctly plotted	2	AO2
	line of best fit		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	a gas escapes (from the test tube)	allow carbon dioxide escapes (from the test tube) ignore copper carbonate thermally decomposes	1	AO1 5.3.1.3

Total Question 2	**8**

Question 3

Question	Answers	Mark	AO / Spec. Ref.
03	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO1 5.2.1.1 5.2.1.2 5.2.1.3 5.2.1.4 5.2.2.3 5.2.2.4
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content: Similarities • both have strong bonds • particles have full outer shells Differences • sodium chloride is a compound • sodium chloride is made from two elements • oxygen is an element • sodium chloride is a giant structure of ions • oxygen is a small molecule • sodium chloride has ionic bonds • sodium chloride consists of oppositely charged ions • electrons are transferred from sodium atoms to chlorine atoms • oxygen is covalent • oxygen (molecules) are made up of oxygen atoms • joined by double covalent bond • electrons are shared between oxygen atoms • with weak forces between oxygen molecules For **Level 2**, there must be a comparison of either the structure **or** bonding of both sodium chloride **and** oxygen, and a description of magnitude.		

Total Question 3	**6**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	completely ionised in aqueous solution	allow completely ionised (when dissolved) in water allow fully dissociated in aqueous solution	1	AO1 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	low concentration of (nitric) acid dissolved in water	allow low concentration of solute / solid / gas dissolved in water	1	AO1 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	decreases by a factor of 100		1	AO2 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols	1	AO1 5.4.2.4

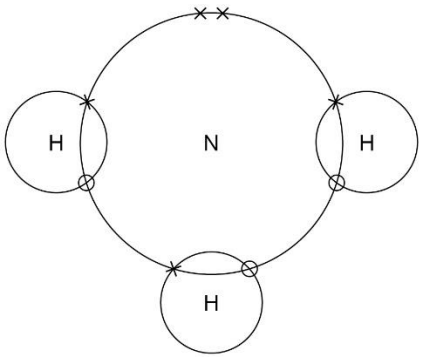
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	1 : 2		1	AO2 5.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	red		1	AO3 5.3.2.4 5.4.2.2 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(for each mass of magnesium carbonate) repeat the experiment (discard anomalous results) **and** calculate the mean		1	AO3 5.5.1.1 RPA10
	measure the highest temperature		1	

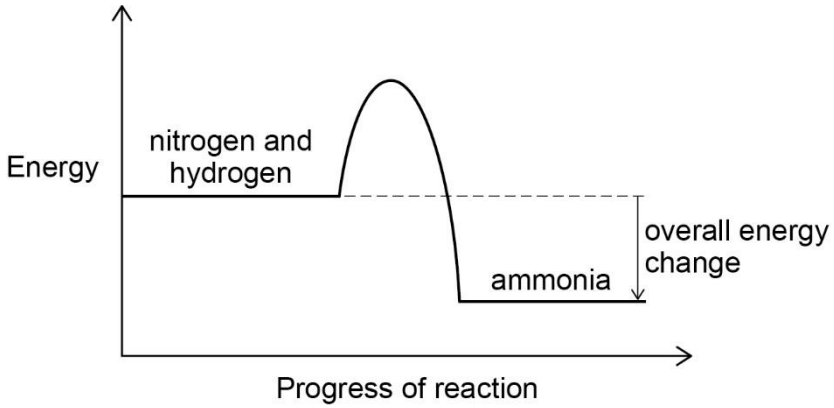
Total Question 4	**8**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		allow any combination of circles, dots, crosses or $e^{(-)}$ ignore any inner shell electrons on nitrogen		AO1 5.2.1.4
	one shared pair of electrons in each overlap		1	
	2 non-bonding electrons on the outer shell of nitrogen	do **not** accept non-bonding electrons on hydrogen	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(M_r NH_3 = 14 + (3 × 1) =) 17		1	AO2 5.3.1.1 5.3.2.2
	$\left(\text{moles } NH_3 = \frac{25}{17}\right)$ = 1.47 (mols)	allow correct use of incorrectly determined M_r of NH_3	1	
	(moles H_2 = 1.47 × $\frac{3}{2}$) = 2.205 (mols)	allow correct use of an incorrectly calculated value of moles of NH_3	1	
	(mass H_2 = 2.205 × 2) = 4.41 (g)	allow 4.4117647 (g) correctly rounded to at least 2 significant figures allow correct use of an incorrectly calculated value of moles of H_2	1	
	alternative approach (2 × M_r NH_3 = 17 × 2 =) 34 (1) 6 g H_2 → 34 g NH_3 (1)	allow correct use of an incorrectly calculated value of 2 × M_r NH_3		
	$\frac{6}{34}$ × 25 (g) H_2 → 25 g NH_3 (1) 4.41 (g H_2 → 25 g NH_3) (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(bonds broken =) 945 + 3**X**		1	AO2 5.5.1.1 5.5.1.3
	(bonds made = 6 × 391 =) 2346		1	
	(energy released = bonds made – bonds broken =) 93 = 2346 – [945 + 3**X**]	allow correct use of incorrectly determined value(s) of bonds broken and/or bonds formed	1	
	(3**X** =) 1308 (kJ/mol)		1	
	(**X** =) 436 (kJ/mol)	allow correct use of an incorrectly determined value for 3**X**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	correct shape for exothermic reaction with the product line below the level of the reactants line		1	AO2
	labelled horizontal lines for reactants and product	labelled horizontal lines for nitrogen and hydrogen and ammonia	1	AO1
	labelled overall energy change		1	AO1 5.5.1.2
	an answer of  scores **3** marks			

Total Question 5	**14**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	gold	allow Au allow silver / Ag allow platinum / Pt allow copper / Cu	1	AO1 5.4.1.2 5.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	reduction by carbon	allow heating / reacting with carbon	1	AO3 5.4.1.2 5.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	cryolite		1	AO1 5.4.3.1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	oxygen is produced		1	AO1 5.4.3.1
	(which) reacts with the carbon / electrode / anode to form carbon dioxide		1	5.4.3.2 5.4.3.3
	(so the electrode) has to be continually replaced	allow (so) the electrode is used up allow (so) the electrode burns away	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	$Al^{3+} + 3e^- \rightarrow Al$	allow **1** mark for $Al^{3+} + e^- \rightarrow Al$ with no / incorrect balancing numbers	2	AO2 5.4.3.1 5.4.3.2 5.4.3.3 5.4.3.5

Total Question 6	**8**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	each calcium atom loses two electrons	allow **1** mark for calcium atoms lose electrons **and** chlorine atoms gain electrons	1	AO2 5.1.2.6 5.2.1.1
	(and) each chlorine atom gains one electron		1	
	(so) one calcium atom reacts with two chlorine atoms		1	
	(to form) Ca^{2+} ions **and** Cl^- ions **or** (to form) calcium ion(s) **and** chloride ion(s)	allow (to form) ions with full outer shells allow energy level for shell	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2		allow converse for bromine allow energy level for shell		AO1 5.1.2.3 5.1.2.6
	chlorine has fewer shells	allow chlorine is a smaller atom	1	
	(so the) outer shell is closer to the nucleus	allow (so the) outer electrons are closer to the nucleus allow (so there) is less shielding	1	
	(so) stronger attraction between nucleus and electron gained **or** (so) stronger attraction between nucleus and outer shell		1	
	(so) gains the electron more easily		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	as the relative formula mass increases the boiling points (of the hydrogen halides) increase		1	AO3 5.1.2.6
	(but) HF has the highest boiling point **or** (but) HF does not follow the trend	allow (but) HF is anomalous	1	

Total Question 7	**10**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	hexagonal (rings of carbon atoms)		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **one** from: • nanotechnology • materials	ignore references to electronic use allow suitable use such as: • sporting equipment • body armour allow drug delivery	1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(number of moles =) $\frac{2380}{6.02 \times 10^{23}}$ $= 3.95 \times 10^{-21}$ (mols)	 allow 3.953488×10^{-21} (mols) correctly rounded to at least 2 significant figures	1 1	AO2 5.2.3.3 5.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	each (carbon) atom forms three covalent bonds (so) one electron from each (carbon) atom is delocalised (so these) delocalised electrons carry (electrical) charge through the structure / nanotube	 ignore throughout for through ignore current / electricity	1 1 1	AO3 5.2.3.3

Total Question 8	**7**