GCSE
Combined Science: Trilogy

8464/C/1H – Chemistry Paper 1 – Higher Tier

Mark scheme

8464

June 2018

Version/Stage: 1.1 Final

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 Assessment Writer.

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

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
- 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 confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

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**. Different terms in the mark scheme are shown by a / ; 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 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

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

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 is 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 ecf 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 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.

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 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.

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.

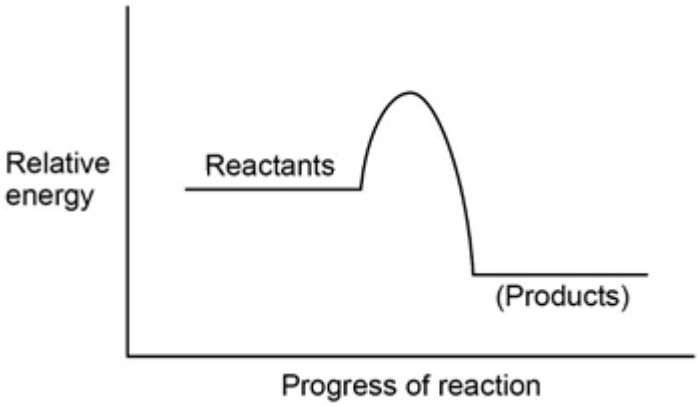
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

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.

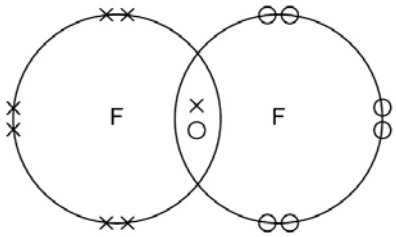
An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	chlorine		1	AO2 5.4.3.4
01.2	copper is less reactive than hydrogen		1	AO2 5.4.3.4
01.3	1.8 (mg)	allow an answer in range 1.7–1.9	1	AO3 5.4.3.4
01.4	$\frac{3.02 + 3.01 + x}{3} = 3.06$ 3.15 (mg)	an answer of 3.15 (mg) scores **2** marks allow any other suitable method if no other mark awarded allow 9.18 for **1** mark	1 1	AO2 5.4.3.4
01.5	$\frac{50}{1000}$ **or** $\frac{1}{20}$ **or** 0.05 (0.05) × 300 15 (g) **or** $\frac{300}{1000}$ **or** $\frac{3}{10}$ **or** 0.03 (1) (0.3) × 50 (1) 15 (g) (1)	an answer of 15 (g) scores **3** marks the second mark is dependent on the first mark being scored the second mark is dependent on the first mark being scored if no other mark awarded allow 150 **or** 15 000 for **1** mark	1 1 1	AO2 5.3.2.5
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(difference) sodium has one and chlorine has seven electrons in <u>outer</u> level / shell **or** number of electrons	number of electrons must be correct if quoted	1	AO2 5.1.1.7 5.1.2.1
	(similarity) both have three / same number of levels / shells **or** have electrons in third level / shell **or** both have incomplete (outer) levels / shells	allow both have 2 electrons in inner shell **or** both have 8 electrons in second shell **or** both are one electron away from full outer level / shell	1	
02.2		allow marks from suitable diagram(s)		AO1 5.2.1.2
	sodium (atom) loses	allow moves / transfers for loses do **not** accept sodium ion loses	1	
	one (outer shell electron)		1	
	chlori<u>n</u>e (atom) gains	do **not** accept chlori<u>d</u>e	1	
	one (electron)		1	
		transfer of 1 electron from chlorine to sodium **max 2** marks reference to sharing **or** covalent bonding **max 3** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3		ignore labels any curve / line going up and then down products line below reactants allow curve to start / finish anywhere along reactant / product lines	1 1	AO1 5.5.1.2
Total			**8**	

Question	Answers	Mark	AO / Spec. Ref.
03	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content: • uses sulfuric acid not hydrochloric acid **or** sulfuric acid needed • uses copper carbonate / oxide not calcium carbonate **or** copper carbonate / oxide needed • add solid until solid remains **or** is in excess **or** no more reacts / dissolves so that most / all of the acid reacts • filter to remove excess **or** unreacted carbonate / oxide / solid • heat gently **or** partially evaporate **or** leave until crystals appear **or** to crystallise for **level 3** the correct chemicals must have been selected		5.4.2.3
Total		**6**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	g	do **not** accept upper case (G) do **not** accept gas	1	AO1 5.1.2.6
04.2		one shared pair anywhere in overlap between two circles **or** on intersection 6 other electrons on each atom allow dots **or** crosses **or** mixture for all marks ignore any inner shell electrons	1 1	AO1 5.1.2.6 5.2.1.4 AO2 5.1.2.6 5.2.1.4
04.3	18		1	AO2 5.1.1.5 5.1.2.6
04.4	$AlBr_3$ **2** Al + **3** Br_2 (→ 2 $AlBr_3$)	ignore state symbols ignore charges ignore brackets as eg $Al(Br)_3$ allow **1** mark for balancing their equation with an incorrect product	 1 1	AO2 5.1.1.1 5.1.2.6

04.5		**max 2** if outer shell / level not mentioned 'it' refers to chlorine allow converse reasons for bromine being less reactive		
	chlorine is a smaller atom **or** has fewer energy levels **or** outer shell closer to nucleus	ignore chlorine has fewer electrons	1	AO1 5.1.2.6
	chlorine has less shielding **or** has the greater attraction between the nucleus and the outer shell **or** incoming electron		1	AO1 5.1.2.6
	therefore chlorine can gain an electron (into the outer shell) more easily		1	AO2 5.1.2.6
		if no other marks awarded allow **1** mark for correct trend in reactivity in Group 7 do **not** accept reference to incorrect particles eg chloride atom		

Total			**9**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		**max 2** for incorrect reference to particles or bonds		AO1 5.2.3.1
	covalent bonds		1	
	giant structure / macromolecule	allow each C has 4 bonds allow giant covalent structure for **2** marks allow giant ionic / lattice structure for **1** mark ignore lattice	1	
	lots of <u>energy</u> needed to break / overcome	allow disrupt structure ignore heat and high temperature	1	
		if no other marks awarded allow **1** mark for strong / many bonds		
05.2		**max 2** for incorrect reference to particles or bonds		AO1 5.2.2.3
	dissolved (in water) **or** aqueous	allow in solution	1	
	molten / liquid		1	
	so ions are mobile **or** free moving		1	
05.3		**max 2** for incorrect reference to particles or bonds		AO1 5.2.1.5 5.2.2.8
	<u>delocalised</u> electrons (from outer shell)		1	
	(free to) move		1	
	energy transferred (through structure)	ignore conducts thermal energy ignore electricity	1	
		if no other mark awarded allow **1** mark for ions / atoms vibrate		
Total			**9**	

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>06.1</td><td>CaO

CO_2</td><td>either order
ignore names</td><td>1

1</td><td>AO1
5.3.1.3</td></tr>
<tr><td>06.2</td><td>

[12 + (3 × 16)]
or 60

(197 − 60 =) 137

barium or Ba</td><td>an answer of 137 scores the 2 calculation marks

barium or Ba without working scores this mark</td><td>

1

1

1</td><td>AO2
5.3.1.2
5.3.1.3
5.1.1.5</td></tr>
<tr><td>06.3</td><td>

(working) Y increase <u>and</u> X increase measured from graph <u>and</u> substitution into $\frac{\Delta Y}{\Delta X}$

(answer) 167

(units) cm^3/g</td><td>an answer of 160–174 scores the 2 calculation marks

<table><tr><td>y-axis</td><td>80–85</td><td>162–170</td><td>248–252</td><td>330–335</td></tr><tr><td>x-axis</td><td>0.5</td><td>1.0</td><td>1.5</td><td>2.0</td></tr><tr><td>=</td><td>160–170</td><td>162–170</td><td>165–168</td><td>165–168</td></tr></table>
allow answer in range 160–174

allow $cm^3\ g^{-1}$

if no other mark awarded allow 1 mark for the inverse ($\frac{\Delta X}{\Delta Y}$)
or 0.006</td><td>

1

1

1</td><td>AO2
5.3.1.2
5.3.1.3</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		an answer of 140–150 scores **4** marks an answer of 0.14–0.15 scores **3** marks		AO3 5.3.1.2 5.3.1.3
	(from graph) volume to 240 cm^3 mass = 1.45 g	allow answer based on any reading from the graph (eg 250 cm^3 = 1.5 g)	1	
	ratio is $\frac{1}{100}$ (ie $\frac{24\,000}{240}$)	allow ratio from their volume eg $\frac{24\,000}{250}$	1	
	100×1.45	$\left(\frac{24\,000}{250}\right) \times 1.5$	1	
	145	allow range 140–150	1	
	or allow method using answer from question **06.3**			
	$x = \frac{y}{m}$ (1)	(rearrangement of y = mx where m = answer from question **06.3**)		
	24 (dm^3) to 24 000 (cm^3) (1)			
	$\frac{24\,000}{\text{answer from question } \mathbf{06.3}}$ (1)			
	144 (1)	allow range 140–150		
Total			**12**	

Question	Answers	Mark	AO / Spec. Ref.
07.1	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1 AO2
	No relevant content	0	
	Indicative content: A is sodium oxide B is phosphorus oxide C is magnesium oxide D is silicon dioxide **linked statements:** A is sodium oxide because it has highest pH **or** pH = 14 **or** is a strong alkali B is phosphorus oxide because it has lowest pH **or** pH = 3 **or** is an acid C is magnesium oxide because it has 2nd highest pH **or** pH = 9 **or** is a (weak) alkali D is silicon dioxide because it is neutral **or** pH = 7 **or** A and B are sodium oxide **or** phosphorus oxide because both soluble **or** no solid remains C is magnesium oxide because it will be the colourless <u>solution</u> with solid remaining D is silicon dioxide because it will be the colourless <u>liquid</u> with solid remaining for **level 3** the solids must be correctly identified		5.1.2.3 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2		an answer of (pH=) 5 gains **2** marks		
	dilution by a factor of 100	allow pH changes by 1 when solution is diluted by factor of 10 **or** allow pH changes by 2	1	AO1 5.4.2.5
	(pH=) 5		1	AO3 5.4.2.5
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	hydrogen **or** H_2	allow hydrogen gas ignore H without the 2 subscript	1	AO1 5.4.2.1
08.2	filtration / filter	allow magnet **or** decant ignore heating	1	AO1 5.1.1.2
08.3		an answer of 185–190 (mg) scores **5** marks an answer of 0.185–0.19 scores **4** marks		AO2 5.3.2.2
	(Mg) $\frac{0.12}{24}$ or 0.005 (moles)	mark is for ÷ by 24	1	
	(Fe) $\frac{2}{3} \times 0.005 = 0.00333$(moles)	mark is for $\times \frac{2}{3}$	1	
	(mass Fe) = 0.00333 × 56	mark is for × 56	1	
	= 0.1866 (g)		1	
	= 187 (mg)		1	
		an answer of 280 (mg) scores **4** marks an answer of 0.280 scores **3** marks (no ratio from equation) 184 scores **0** [=(3×24) + (2×56)]		
	OR			
	(Mg) = $\frac{0.12}{(3 \times 24 =)\ 72}$ (1)			
	= 0.00166 **or** $\frac{1}{600}$ (moles) (1)			
	(mass of Fe) = 0.00166			
	or $\frac{1}{600} \times 112\ (2 \times 56)$ (1)			
	= 0.1866 (g) (1) 187 (mg) (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3 cont.	**OR** 72 g Mg → 112g Fe (1) 1 g Mg → $\frac{112}{72}$ **or** 1.56 g Fe (1) 0.12 g Mg → $\frac{112}{72}$ × 0.12 (1) = 0.1866 (g) (1) = 187 (mg) (1)			
08.4	Fe^{3+} (because) reduction is gain <u>of electrons</u> $Fe^{3+} + 3e^{(-)}$ ➔ Fe	allow change in oxidation state / (+)3 to 0	1 1 1	AO2 AO1 AO2 5.4.1.2 5.4.1.4
Total			**10**	