GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1H

Chemistry Paper 1H

Mark scheme

June 2023

Version: 1.0 Final

2 3 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.

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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 confuse 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 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	hydrogen / H^+		1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2		MP2 is dependent upon MP1 being awarded		AO1 5.4.2.4
	(indicator) universal	ignore pH meter	1	
	(result) (green to) red / orange / yellow		1	
	OR			
	(indicator) (blue) litmus (1)			
	(result) (turns) red (1)			
	OR			
	(indicator) methyl orange (1)			
	(result) (turns) red (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the solubility decreases		1	AO3 5.3.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	pH of the solution increases		1	AO3 5.3.2.5 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(I)		1	AO2 5.2.2.2

Question	Answers	Mark	AO / Spec. Ref.
01.6	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 5.3.1.3 5.4.2.2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative Content: • measure a (stated) mass of calcium carbonate • use a balance • add calcium carbonate into a conical flask • measure a (stated) volume of hydrochloric acid • use a measuring cylinder • add hydrochloric acid to the conical flask • immediately place the stopper (and delivery tube) in the conical flask • record the total volume of carbon dioxide gas **or** record volume of carbon dioxide collected in set time **or** time taken to collect fixed volume of gas • collected in the gas syringe • repeat • repeat method with different masses of calcium carbonate		

Total Question 1	**12**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	neutralisation	allow exothermic	1	AO1 5.4.2.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(M_r =) (1 × 2) + 32 + (4 × 16) = 98		1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(A_r O × 4 =) 4 × 16 **or** 64 (percentage of oxygen =) $\frac{64}{110} \times 100$ = 58.18 = 58 (%)	 allow correct use of incorrectly determined mass of oxygen allow a correctly calculated answer to 2 significant figures from an incorrect calculation which uses the values in the question	1 1 1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(unit conversion) (25 cm^3 ÷ 1000) = 0.025 dm^3		1	AO2 5.3.2.5
	(conc =) $\frac{0.30}{0.025}$ (g/dm^3)	allow correct use of incorrect / no unit conversion	1	
	= 12 (g/dm^3)		1	
	alternative approach: $\frac{0.30}{25}$ (g/cm^3) (1) = 0.012 (g/cm^3) (1) (unit conversion) (0.012 × 1000) = 12 (g/dm^3) (1)	allow correct conversion of an incorrect concentration calculation		

Total Question 2	**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$4\,Na + O_2 \rightarrow 2\,Na_2O$	allow multiples	1	AO2 5.1.1.1 5.1.2.5 5.3.1.1 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	sodium atom loses one electron		1	AO1 5.1.1.7 5.1.2.3
	(and) oxygen atom gains two electrons		1	5.1.2.5 5.2.1.2
	(so) two sodium atoms to one oxygen atom		1	
	any **one** from: • (to form) Na^+ **and** O^{2-} • (to form) sodium ion(s) **and** oxide ion(s) • (to form) ions with full outer shells / levels.		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	yellow flame	allow orange flame	1	AO1 5.1.2.5
	any **one** from: • sodium melts • white smoke / solid / powder		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(potassium) (burns with a) lilac flame	allow (burns with a) different colour flame	1	AO1 5.1.2.5
	burns faster	allow more vigorous reaction	1	

Total Question 3	**9**

Question 4

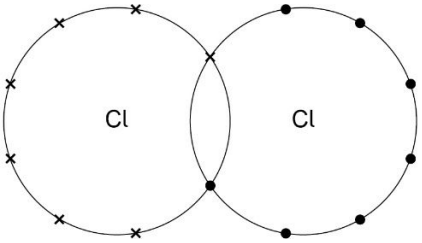
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	electron → proton → neutron		1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(times heavier =) $\frac{1.673 \times 10^{-27}}{9.109 \times 10^{-31}}$ = 1837	 allow 1836.645076 correctly rounded to at least 3 significant figures	1 1	AO2 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	46		1	AO2 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	36		1	AO2 5.1.1.4 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(A_r =) $\frac{(35 \times 75.77) + (37 \times 24.23)}{100}$ = 35.4846 = 35.48	 allow an answer correctly calculated to 2 decimal places from an incorrect calculation which uses the values in the question	1 1 1	AO2 5.1.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6		allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons		AO1 5.1.2.6 5.2.1.1
	one shared pair in overlap		1	5.2.1.4
	each chlorine atom with 6 non-bonded electrons (on outer shell)	ignore any inner shell electrons	1	
		the diagram below scores 2 marks		
				

Total Question 4	**10**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	ions are not free to move		1	AO1 5.2.2.3 5.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	liquid **or** molten	allow (when) the solid is melted ignore references to aqueous solutions ignore references to dissolving	1	AO1 5.4.3.1 5.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	carbon / graphite	allow platinum / gold / silver	1	AO3 5.4.3.1 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$2\ Cl^- \rightarrow Cl_2 + 2\ e^-$	ignore state symbols allow **1** mark for $Cl_2 + e^-$	2	AO2 5.4.1.4 5.4.3.1 5.4.3.4 5.4.3.5 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	water (molecules) break down to produce (equal numbers of) H^+ and OH^- (ions)		1	AO3
	(so) the hydrogen / H^+ ions are attracted to the negative electrode (where) hydrogen ions are discharged / reduced		1	AO1
	(because) hydrogen is less reactive than sodium		1	AO3
	(so there is) a decrease in (the relative number of) hydrogen / H^+ ions **or** (so there is) an increase in the relative number of hydroxide / OH^- ions		1	AO3 5.4.2.4 5.4.3.1 5.4.3.4 5.4.3.5 RPA9

Total Question 5	**9**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	filter (to remove excess magnesium) (then) crystallisation (of magnesium chloride solution)	 allow (then) evaporation (of water from magnesium chloride solution)	1 1	AO1 5.1.1.2 5.4.2.1 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(magnesium atoms are) oxidised (because the atoms) lose (two) electrons		1 1	AO2 5.4.1.4 5.4.2.1 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(moles Mg =) $\frac{0.72}{24}$		1	AO2 5.3.1.1 5.3.2.2 5.4.2.1 5.4.2.3 RPA8
	= 0.03		1	
	(moles Mg = moles $MgCl_2$) (so mass $MgCl_2$ =) 0.03 × 95	allow a correct calculation using an incorrectly calculated value of moles of magnesium allow a correct calculation using an incorrectly calculated value of moles of magnesium chloride	1	
	= 2.85 (g)		1	
	(100.0 cm^3 = 0.100 dm^3 concentration = $\frac{\text{mass}}{\text{volume}}$)			
	= $\frac{2.85}{0.100}$	allow correct use of incorrectly calculated mass of magnesium chloride	1	
	= 28.5 (g/dm^3)		1	

Total Question 6	**10**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	fullerenes and graphene		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	delocalised electrons		1	AO1 5.2.1.5
	(which) move through the structure		1	5.2.2.8
	(and) transfer energy		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	strong (electrostatic) forces of attraction		1	AO1 5.2.1.3 5.2.2.3
	(between the) oppositely charged ions		1	
	(so) large amounts of energy needed to break the many / strong bonds / forces	allow (so) large amounts of energy needed to break the bonds / forces in all directions allow (so) large amounts of energy needed to break the bonds in the lattice	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	small molecules	allow simple molecules	1	AO1 5.2.1.4 5.2.2.4
	(with) weak forces between the molecules **or** (with) weak intermolecular forces	allow (with) weak intermolecular bonds do **not** accept incorrect references to covalent bonds	1	
	(so) little energy required to overcome / break the forces between molecules **or** (so) little energy required to overcome / break the intermolecular forces	allow (so) little energy required to separate the molecules allow (so) little energy required to overcome / break the intermolecular bonds ignore less energy	1	

Total Question 7	**10**