



GCSE
COMBINED SCIENCE: TRILOGY
8464/C/2H

Chemistry Paper 2H

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme



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.

Further copies of this mark scheme are available from aqa.org.uk

Copyright information

AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2022 AQA and its licensors. All rights reserved.

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 **not** 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 pairs from: (start) line drawn in ink (1) (so ink) will mix with solvent (1) the solvent is above the (start) line (1) (so) colours / ink will dissolve (1) no lid on tank (1) (so) solvent will evaporate (1)	allow (start) line should be drawn in pencil allow the ink will move up the paper allow the solvent should be below the (start) line	4	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any two from: <ul style="list-style-type: none"> • (the brown ink) contains the blue, yellow and red (colours) • (the brown ink) contains an unknown colour • (the brown ink) does not contain green ink • blue (colour) is the most soluble or red (colour) is the least soluble 	allow blue (colour) has the highest R_f value allow red (colour) has the lowest R_f value ignore green colour is insoluble	2	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the green colour was insoluble in the solvent		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$0.24 = \frac{1.8}{\text{distance moved by solvent}}$		1	AO2 5.8.1.3 RPA12
	(distance moved by solvent =) $\frac{1.8}{0.24}$		1	
	$= 7.5 \text{ (cm)}$		1	

Total Question 1		10
-------------------------	--	-----------

Question 2

Question	Answers	Mark	AO / Spec. Ref.																		
02.1	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 5.10.1.3																		
	Level 1: Relevant features are identified and differences noted.	1–3																			
	No relevant content	0																			
	<p>Indicative content</p> <table border="1" data-bbox="293 819 1177 1823"> <thead> <tr> <th data-bbox="293 819 735 869">ground water</th> <th data-bbox="735 819 1177 869">waste water</th> </tr> </thead> <tbody> <tr> <td data-bbox="293 869 735 913">easier to obtain</td> <td data-bbox="735 869 1177 913">more difficult to obtain</td> </tr> <tr> <td data-bbox="293 913 735 958">fewer processes</td> <td data-bbox="735 913 1177 958">more processes</td> </tr> <tr> <td data-bbox="293 958 735 1003">takes less time</td> <td data-bbox="735 958 1177 1003">takes more time</td> </tr> <tr> <td data-bbox="293 1003 735 1115">filtered through filter beds to remove insoluble particles</td> <td data-bbox="735 1003 1177 1115">screening and grit removal to remove large particles</td> </tr> <tr> <td data-bbox="293 1115 735 1261"></td> <td data-bbox="735 1115 1177 1261">sedimentation to produce sewage sludge and effluent</td> </tr> <tr> <td data-bbox="293 1261 735 1406"></td> <td data-bbox="735 1261 1177 1406">aerobic biological treatment of effluent to reduce solid waste</td> </tr> <tr> <td data-bbox="293 1406 735 1608">sterilised using chlorine, ozone or uv light to kill bacteria</td> <td data-bbox="735 1406 1177 1608">and then sterilised using chlorine, ozone or uv light to kill bacteria</td> </tr> <tr> <td data-bbox="293 1608 735 1823"></td> <td data-bbox="735 1608 1177 1823">sludge is anaerobically digested by specific bacteria to remove organic matter</td> </tr> </tbody> </table>	ground water	waste water	easier to obtain	more difficult to obtain	fewer processes	more processes	takes less time	takes more time	filtered through filter beds to remove insoluble particles	screening and grit removal to remove large particles		sedimentation to produce sewage sludge and effluent		aerobic biological treatment of effluent to reduce solid waste	sterilised using chlorine, ozone or uv light to kill bacteria	and then sterilised using chlorine, ozone or uv light to kill bacteria		sludge is anaerobically digested by specific bacteria to remove organic matter		
ground water	waste water																				
easier to obtain	more difficult to obtain																				
fewer processes	more processes																				
takes less time	takes more time																				
filtered through filter beds to remove insoluble particles	screening and grit removal to remove large particles																				
	sedimentation to produce sewage sludge and effluent																				
	aerobic biological treatment of effluent to reduce solid waste																				
sterilised using chlorine, ozone or uv light to kill bacteria	and then sterilised using chlorine, ozone or uv light to kill bacteria																				
	sludge is anaerobically digested by specific bacteria to remove organic matter																				

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	distillation		1	AO1 5.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(conversion) $\frac{150}{1000} = 0.15 \text{ (dm}^3\text{)}$	allow correct use of incorrect / no conversion	1	AO2 5.3.2.5
	(concentration =) $\frac{2.40}{0.15}$		1	
	= 16 (g/dm ³)		1	
02.3	OR (conversion) $\frac{1000}{150} \text{ (1)}$			
	= 6.67 (1)			
	(6.67 × 2.4) = 16 (g/dm ³) (1)			
02.3	OR (concentration =) $\frac{2.4}{150} \text{ (1)}$			
	= 0.016 (1)			
	(conversion) (0.016 × 1000) = 16 (g/dm ³) (1)			

Total Question 2		10
-------------------------	--	-----------

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	sulfur dioxide produced	allow a gas is produced	1	AO3
	(which) escapes from the (conical) flask		1	AO2
				5.2.2.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	dependent		1	AO2 5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	all points correctly plotted	allow 1 mark for 3, 4 or 5 points correctly plotted	2	AO2
	line of best fit	allow a tolerance of $\pm \frac{1}{2}$ a small square	1	AO3 5.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	correct values for x step and y step from tangent		1	AO2 5.6.1.1 RPA11
	(rate =) $\frac{\text{value for y step}}{\text{value for x step}}$	allow correct use of an incorrectly determined value from tangent for x step and/or y step	1	
	correct calculation of rate		1	
	s dm ³ /mol		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(as reaction proceeds) fewer (sodium thiosulfate) particles per unit volume	allow (as reaction proceeds) concentration (of sodium thiosulfate) decreases	1	AO2 5.6.1.2 5.6.1.3 RPA11
	(so) frequency of (particle) collisions decreases	allow (so) probability of collision decreases	1	

Total Question 3		12
-------------------------	--	-----------

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	butane		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_{11}H_{24} \rightarrow C_5H_{10} + 2C_2H_4 + C_2H_6$ OR $C_{11}H_{24} \rightarrow C_5H_{10} + 2C_3H_6 + H_2$ (2) OR $C_{11}H_{24} \rightarrow C_5H_{10} + 2C_2H_6 + C_2H_2$ (2)	allow 1 mark for $2C_2H_4$ allow 1 mark for C_2H_6 allow 1 mark for $2C_3H_6$ allow 1 mark for H_2 allow 1 mark for $2C_2H_6$ allow 1 mark for C_2H_2	2	AO2 5.1.1.1 5.3.1.1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<p>04.4</p>	<p>C₂H₆ is useful as a fuel</p> <p>(because more) flammable (than larger molecules)</p> <p>OR</p> <p>C₂H₄ / C₃H₆ / C₅H₁₀ is used to make polymers (1)</p> <p>(because more) reactive (than alkanes) (1)</p>	<p>allow smaller molecule so useful as a fuel</p> <p>allow C₂H₄ / C₃H₆ / C₅H₁₀ is used to make plastics</p> <p>allow C₂H₄ / C₃H₆ / C₅H₁₀ is used to make other chemicals</p> <p>if a named product is given, allow 1 mark for a correct use and 1 mark for a correct linked reason</p>	<p>1</p> <p>1</p>	<p>AO1 5.7.1.3 5.7.1.4</p>

Question	Answers	Mark	AO / Spec. Ref.
04.5	Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3 5.9.2.2 5.10.1.1 5.10.2.1
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	<p>Indicative content</p> <ul style="list-style-type: none"> • production of plastic uses more hydrocarbons which are from non-renewable crude oil • production of plastic produces more greenhouse gases in the atmosphere which contributes to global warming • production of plastic produces more sulfur dioxide which causes acid rain • production of plastic produces more oxides of nitrogen which cause acid rain and respiratory problems • disposal of plastic produces more waste which increases landfill • burning plastic produces fumes which are toxic so cause respiratory problems • lifetime cost of plastic frames is less • plastic frames have lower costs for maintaining • the total energy consumption for plastic frames is greater than for wooden frames • judgement 		

Total Question 4		12
-------------------------	--	-----------

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	nitrogen increased	allow (because of) denitrifying bacteria	1	AO1 5.9.1.2 5.9.1.3
	(because of) emission from volcanoes		1	
	oxygen increased		1	
	(because of) photosynthesis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	carbon dioxide is used during photosynthesis		1	AO1 5.9.1.4
	in trees		1	
	(which) die and are compressed		1	
	over millions of years		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	coal has a higher proportion / percentage of carbon		1	AO2 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	uses bacteria to produce solutions containing copper compounds from which copper is obtained by displacement / electrolysis	allow to produce leachate solutions	1 1 1	AO1 5.10.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	1000 (kg of plants) gives 7.92 (kg of nickel)		1	AO2 5.10.1.4
	$(\text{mass} = \frac{7.92}{4.8} \times 100 =) 165 \text{ (kg)}$		1	
	(conversion 165 kg =) 165 000 (g)	allow correct conversion of an incorrectly determined mass in kg	1	
	= 1.65×10^5 (g)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams	1	
	OR			
	$(\text{mass} =) \frac{0.792}{4.8} \times 1000 \text{ (1)}$			
	= 165 (kg) (1)			
	(conversion 165 kg =) 165 000 (g) (1)	allow correct conversion of an incorrectly determined mass in kg		
= 1.65×10^5 (g) (1)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams			

Total Question 5		16
-------------------------	--	-----------

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	enzyme		1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	provides a different reaction pathway (which) has a lower activation energy		1 1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	the effects of changing conditions on the position of an equilibrium (in a closed system)	allow the effects of changing conditions on the yield of an equilibrium reaction (in a closed system)	1	AO1 5.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(when) the forward and reverse reactions have the same rate in apparatus which prevents the escape of reactants and products	allow in a closed system	1 1	AO1 5.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	yield increases	allow (because) there are fewer moles (of gas) on the right hand side	1	AO2
	(because) there are more moles (of gas) on the left hand side		1	5.6.2.1 5.6.2.2 5.6.2.3 5.6.2.4 5.6.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	yield decreases		1	AO2
	(because) the system shifts in the endothermic direction		1	5.6.2.1 5.6.2.2 5.6.2.3 5.6.2.4 5.6.2.6

Total Question 6		10
-------------------------	--	-----------