GCSE
COMBINED SCIENCE: TRILOGY
8464/C/2H

Chemistry Paper 2H

Mark scheme

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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

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 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	$C_{12}H_{26}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **one** from: • (a water bath) will control the temperature • (a water bath) will not set dodecane on fire	 allow dodecane is flammable	1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	volume of dodecane		1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	line extrapolated to 75 °C value at 75 °C read from extrapolated line	 allow a tolerance of ± ½ a small square	1 1	AO3 AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	 as the temperature increases the time taken decreases (so) the viscosity decreases	ignore references to rate	 1 1	AO3 5.7.1.3

Total Question 1	**7**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(test) glowing splint (result) relights	do **not** accept burning / lit splint allow glows more brightly MP2 is dependent upon MP1 being awarded	1 1	AO1 5.8.2.2

Question	Answers	Mark	AO / Spec. Ref.
02.2	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO3
	No relevant content	0	5.9.1.1 5.9.1.2 5.9.1.3 5.9.1.4
	Indicative content • **the percentage of carbon dioxide has decreased** o (because) carbon dioxide dissolved in the oceans o forming sediments o (because) algae / plants o photosynthesised o by the formation of sedimentary rocks o by the formation of fossil fuels • **the percentage of nitrogen has increased** o (because) volcanic activity produced nitrogen o denitrifying bacteria released nitrogen • **the percentage of oxygen has increased** o (because) algae / plants o photosynthesised for **Level 3** answers must include each of the gases with an explanation for different gases		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	any **two** from: • reduce livestock farming • reduce the number of rice / paddy fields • reduce the amount of rubbish going to landfill • use methane from landfill as an energy source • reduce fossil fuel use • reduce the destruction of peat bogs	 allow reduction of specific animals / product allow reduce area of wetlands allow recycle more (so less rubbish to landfill)	2	AO1 5.9.2.2 5.9.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	fossil fuels (containing sulfur) are burnt sulfur reacts with oxygen (to produce sulfur dioxide)	allow fuels containing sulfur are burnt	1 1	AO1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	any **one** from: • respiratory problems • acid rain	 allow immediate consequence of acid rain	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6		allow any named fossil fuel		AO3 5.9.3.1
	any **one** from:		1	
	• less use of fossil fuels (containing sulfur)	allow less use of fuels containing sulfur allow increased use of renewable energy allow increased use of electric vehicles		
	• sulfur is removed from fossil fuels (before burning)			
	• sulfur dioxide is removed from waste gases (after burning)			
	• new legislation / regulations (since 1980)			

Total Question 2	**14**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(a resource that) will run out	allow (a resource that) is non-renewable	1	AO1 5.7.1.1 5.10.1.1

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(volume of petrol =) $90 \times 159 \times \frac{31.3}{100}$ **or** (volume of petrol =) $14310 \times \frac{31.3}{100}$ **or** (volume of petrol =) 90×49.767 **or** (volume of petrol =) 28.17×159	allow **1** mark for 90×159 **or** $159 \times \frac{31.3}{100}$ **or** $90 \times \frac{31.3}{100}$	2	AO2 5.7.1.1 5.7.1.2
	= 4479.03		1	
	= 4480 (dm^3)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses 90 barrels, 159 dm^3 and a fraction percentage	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	lubricants		1	AO1 5.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	steam cracking		1	AO1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(test) add bromine water (result) (bromine) changes (from orange) to colourless	 allow (bromine) is decolourised	 1 1	AO2 5.7.1.4

Total Question 3	**10**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	a mixture that has been designed as a useful product		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	91 kJ/mol		1	AO2 5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	Le Chatelier		1	AO1 5.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	the proportion of methanol decreases		1	AO2 5.6.2.4 5.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the proportion of methanol stays the same		1	AO3 5.6.1.4 5.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(increasing the pressure) increases the proportion of methanol		1	AO2 5.6.2.4 5.6.2.7
	(because) there are more molecules / moles of reactant (than product)		1	
	(so) the equilibrium (position) shifts to the side with fewer molecules / moles		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(the catalyst) increases the rate of the reaction		1	AO1 5.6.1.4
	(by) providing an alternative pathway (for the reaction)		1	
	(with) a lower activation energy		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	reduces the costs		1	AO2 5.6.1.4 5.9.2.2
	(because) less energy is used		1	5.9.2.4
	OR			
	less fuels burned (1)			
	(so) less contribution to global warming (1)	allow (so) less carbon dioxide produced		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	$CO_2 + 3\,H_2 \rightarrow CH_3OH + H_2O$	allow multiples allow **1** mark for $CO_2 + H_2 \rightarrow CH_3OH + H_2O$ with no / incorrect balancing numbers	2	AO2 5.3.1.1

Total Question 4	**15**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	time taken (for the cross to be no longer visible)		1	AO1 5.6.1.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	sulfur (is produced)		1	AO2 5.2.2.2 5.6.1.2
	(which is a) solid	allow (which is) insoluble allow (which is) a precipitate	1	RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		allow converse throughout		AO1 5.6.1.2 5.6.1.3
	increasing the concentration increases the rate of reaction		1	
	(because) there are more particles in the same volume (of solution)	allow (because) the particles are closer together do **not** accept the particles have more energy	1	
	(so) there are more frequent collisions		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	to reduce loss of gas	allow to reduce loss of hydrogen do **not** accept to stop loss of gas / hydrogen	1	AO3 5.6.1.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(test) add a burning splint (result) (hydrogen burns with) a pop sound	do **not** accept glowing splint MP2 is dependent upon MP1 being awarded	1 1	AO1 5.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	tangent drawn at 75 s value of *x*-step **and** *y*-step from tangent $(\text{rate}=)\ \frac{\text{value for y-step}}{\text{value for x-step}}$ correct calculation of rate	 allow evidence of use of two points on tangent either on the graph or in the text allow a tolerance of ± ½ a small square allow correct use of incorrectly determined value(s) for *x*-step and/or *y*-step from a drawn tangent 	1 1 1 1	AO2 5.6.1.1 RPA11

Total Question 5	13

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(mass in one phone =) $1.73 \times 10^{-4} \times 197$		1	AO2 5.3.2.1 5.10.1.1
	= 0.034081 (g)		1	
	(total mass =) $0.034081 \times 2.48 \times 10^{6}$	allow (total mass =) $0.034081 \times 2\,480\,000$ allow correct use of an incorrectly determined mass in one phone	1	
	= 84520.88 (g)		1	
	(conversion 84520.88 g =) 84.5 (kg)	allow 84.52088 (kg) correctly rounded to at least 2 significant figures allow conversion at MP2, MP3 allow correct conversion of an incorrectly determined mass using all numbers from the question	1	
	alternative approach			
	(total moles =) $1.73 \times 10^{-4} \times 2.48 \times 10^{6}$ (1)	allow (total moles =) $1.73 \times 10^{-4} \times 2\,480\,000$		
	= 429.04 (1)			
	(total mass =) 429.04 × 197 (1)	allow correct use of an incorrectly determined total moles		
	= 84520.88 (g) (1)			
	(conversion 84520.88 g =) 84.5 (kg) (1)	allow 84.52088 (kg) correctly rounded to at least 2 significant figures allow correct conversion of an incorrectly determined mass using all numbers from the question		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	1.04×10^{20}		1	AO2 5.3.2.1 5.10.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	uses bacteria		1	AO1 5.10.1.4 5.10.2.2
	to produce leachate / solutions containing gold compounds		1	
	from which gold is obtained by displacement / electrolysis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	any **two** from: • high-grade ores still available • land not available • phytomining takes a long time • very small yields produced • new technology		2	AO3 5.10.1.4

Total Question 6	**11**