GCSE
COMBINED SCIENCE: TRILOGY

8464/C/2H - CHEMISTRY PAPER 2 HIGHER TIER

Mark scheme

8464

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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 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	condenses		1	AO1 5.7.1.2
01.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
01.3	propane	do **not** accept propene	1	AO2 5.7.1.1
01.4	C_nH_{2n+2}		1	AO1 5.7.1.1
01.5	$CH_4 + \mathbf{2}\ O_2 \rightarrow CO_2 + \mathbf{2}\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
01.6	bromine water		1	AO1 5.7.1.4
01.7	to assess the environmental impact (of the stages in the life of a product)	allow to see the effect / harm / damage on the Earth / environment / planet ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability	1	AO1 5.10.2.1

Question	Answers	Mark	AO / Spec. Ref.
01.8	**Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.	3–4	AO3
	Level 1: Relevant features are identified and differences noted.	1–2	AO2 AO3
	No relevant content	0	
	Indicative content • burning 10 000 bags produces 10 kg more of carbon dioxide than landfill • putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning. • putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning • burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces15 kg • putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg • landfill produces less carbon dioxide than burning • landfill produces more solid residue than burning • burning produces less sulfur dioxide than landfill		5.10.2.1 5.10.2.2 5.9.2.2
Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	methane		1	AO1 5.9.2.2
02.2	any **two** examples from: • rising sea levels • melting ice • agricultural problems • extremes of weather • loss of habitats	allow effects from the same bullet point ignore global warming ignore acid rain ignore global dimming do **not** accept reference to ozone	2	AO1 5.9.2.3
02.3	$\frac{6.0}{4.1} \times 0.0235$ = 0.0344(kg)	an answer of 0.0344(kg) scores **2** marks allow correct rounding allow calculator reading if no mark awarded: allow **1** mark for 34.4 or 0.344 allow **2** marks for 34.4 g	1 1	AO2 5.9.2.4
02.4	use less plastic **or** use recycled plastic	allow carbon capture ignore any reference to energy / fuels	1	AO1 5.9.2.4 5.10.2.2

Question	Answers	Mark	AO / Spec. Ref.
02.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.	5–6	AO1 5.9.1.2 5.9.1.3 5.9.1.4
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content nitrogen increased • because volcanoes produced nitrogen • because (denitrifying) bacteria produced nitrogen • because ammonia was converted to nitrogen oxygen increased • because algae and plants produced oxygen • by photosynthesis carbon dioxide decreased • because algae and plants used carbon dioxide • by photosynthesis • because oceans formed and carbon dioxide dissolved in the water • because carbon dioxide formed carbonates, which precipitate as sediments or formed sedimentary limestone rocks • because algae / plants and animals formed fossil fuels / coal / crude oil / natural gas		
Total			**12**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	16(.0)		1	AO2 5.10.1.2
03.2	advantage: more accurate result disadvantage: takes a long(er) time, more energy needed (to heat more water)	do **not** accept reliable ignore expensive	1 1	AO3 5.10.1.2
03.3	pure: no dissolved solids / impurities **or** no (dissolved) chlorine **and** potable: has dissolved solids / impurities **or** has (dissolved) chlorine	a clear comparative statement referring to solutes gains the mark allow only water / H_2O ignore safe to drink ignore safe to drink	 1	AO1 5.8.1.1 5.10.1.2
03.4	groundwater: • filtered • sterilised seawater: • distilled **or** reverse osmosis	 allow acceptable method of filtration allow acceptable method of sterilisation allow desalination ignore salt removed ignore boiling alone ignore filtering do **not** accept fractional distillation	 1 1 1	AO1 5.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$\frac{2.2}{100} \times 6.50$ (=) 0.143 (g)	an answer of 0.143 (g) **or** 0.14 (g) scores **2** marks	1 1	AO2 5.10.1.2
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	a mixture designed as a useful product		1	AO1 5.8.1.2
04.2		an answer of 1.8×10^2 (mol) gains **4** marks		AO2 5.8.1.2 5.3.2.1
	mass = 14 520 g		1	
	(=) $\frac{14\ 520}{80\ (\text{mol})}$	allow correct substitution of incorrectly converted mass must use M_r given (80) to gain marks in steps 2 and 3	1	
	(=) 181.5 (mol)		1	
	(=) 1.8×10^2 (mol)	allow answer correctly given in standard form to correct sig figs from an incorrect calculation	1	
04.3		**max 2** marks for incorrect reference to bonding **or** structure **or** particles		AO1 5.2.2.3
	(giant) lattice	allow giant structure	1	
	ionic		1	
	strong bonds **or** strong electrostatic forces	do **not** accept strong intermolecular forces / bonds	1	
	large amounts of energy needed to overcome	ignore heat	1	
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$CaCl_2$ + CO_2 + H_2O	products in any order	1	AO2 5.1.1.1
	balancing: **2** (HCl)	dependent on correct formulae for products	1	5.6.1.2 5.10.2.11
05.2		values must be approximately correct		AO2 5.6.1.1 5.10.2.11
	value from graph used to show volume increase	must include a time or volume value	1	
	values from graph used to show the volume increases less rapidly	must include time interval or volume increment	1	
	volume **or** time stated when graph line levels off	allow levels off at 60 (cm^3) **or** 28 to 30 s allow descriptions in terms of rate of reaction	1	
05.3	draw tangent at <u>15 s</u>	allow draw a straight line on the curve at <u>15 s</u>	1	AO2 5.6.1.1 5.10.2.11
	calculate gradient	allow correct description of gradient calculation ignore calculations if given	1	
05.4	centimetres cubed per second	allow cm^3/s **or** $cm^3\ s^{-1}$ (all lower case) allow mixture of abbreviations and words, eg centimetres cubed/s do **not** accept non-SI abbreviations (eg sec for s)	1	AO1 5.6.1.1 5.10.2.11
05.5	(rate) increases as chips get smaller	allow converse	1	AO3 5.6.1.1 5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	same amount of acid **or** same number of moles of acid	allow same volume of acid allow same concentration of acid allow same mass of $CaCO_3$ / marble chips allow one reactant is the limiting factor	1	AO3 5.3.2.4 5.6.1.1
05.7		an answer of 24 (cm^2) scores **2** marks		AO2 5.6.1.2
	(surface area of each face = 2 × 2 =) 4		1	
	(6 × 4 =) 24 (cm^2)	allow 6 × student's value from step 1	1	
05.8	small(er) chips have large(r) surface area (for the same volume)	allow converse	1	AO3 5.6.1.2 5.6.1.3
	so more frequent collisions	allow more chance of collisions allow more likely to collide do **not** accept reference to speed of particles or energy of collisions ignore more collisions ignore more successful collisions	1	AO1 5.6.1.2 5.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.9	(sloping part is less steep because) reaction is slower	allow converse for more concentrated acid	1	AO2 5.6.1.2 5.6.1.3 10.2.11
	due to less frequent collisions	do **not** accept reference to speed of particles or energy of collisions ignore fewer collisions	1	
	fewer acid particles (in same volume)	ignore weaker acid	1	
	or (sloping part is less steep because) reaction is slower (1) there are fewer acid particles (in same volume) (1) (graph levels off lower) so less gas is produced (1)			
Total			**17**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	damp / moist litmus paper	ignore colour of litmus paper	1	AO1 5.8.2.4
	bleaches / goes white		1	
06.2	forward and reverse rates equal		1	AO1 5.6.2.1 5.6.2.3
	because no escape of reactants or products	allow closed system allow particles for reactants or products	1	AO2 5.6.2.1 5.6.2.3
06.3	equilibrium shifts	allow no longer in equilibrium	1	AO3 5.6.2.3 5.6.2.4 5.6.2.5 5.6.2.7
	to right-hand side	allow in favour of forward reaction	1	
	to produce more of any products **or** to reduce any reactants	allow correct references to Le Chatelier's Principle	1	
	(new) equilibrium will be established		1	
06.4	amount of chlorine gas increases		1	AO2 5.6.2.4 5.6.2.6
	(because) system shifts to counteract the change	allow (because) system shifts to take in energy allow (because) system shifts in endothermic direction	1	AO1 5.6.2.4 5.6.2.6
06.5	no change		1	AO2 5.6.2.4 5.6.2.7
	because equal numbers of molecules **or** moles (of gas) on each side		1	AO1 5.6.2.4 5.6.2.7
Total			**12**	