GCSE
COMBINED SCIENCE: SYNERGY

8465/3H - PAPER 3 PHYSICAL SCIENCES HIGHER TIER

Mark scheme

8465

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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

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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 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.

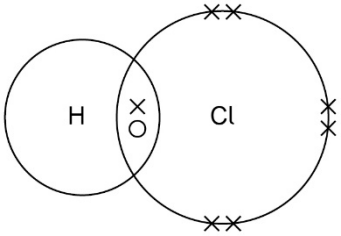
The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine 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.

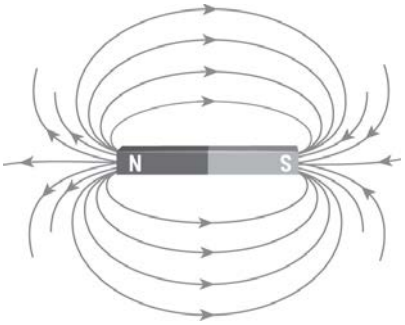
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	shared electron pair	allow electrons drawn as dots, crosses, circles or $e^{(-)}$	1	AO1 4.6.2.4
	1 hydrogen electron and 7 chlorine electrons drawn on outer shells	ignore inner shell electrons drawn on chlorine an answer of  scores **2** marks	1	
01.2	correct symbols and formulae	an answer of $H_2 + Cl_2 \rightarrow 2HCl$ scores **2** marks	1	AO2 4.5.2.1 4.5.1.5
	correct balancing of equation containing HCl	allow correct multiples	1	
01.3	A activation energy		1	AO1 4.7.4.4
	B (overall) energy change		1	
01.4	energy of products is less than the energy of the reactants		1	AO2 4.7.4.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	hydrogen chloride molecules do not have an overall electric charge	allow hydrogen chloride does not contain ions	1	AO1 AO2 4.6.2.3 4.6.2.5
	hydrochloric acid contains ions		1	
	(which) are free to move so charge can flow	do **not** accept reference to delocalised electrons	1	
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	limewater (which) turns cloudy / milky (when carbon dioxide is added)	allow calcium hydroxide solution must link to limewater	1 1	AO1 4.7.3.1
02.2	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO1 4.7.3.2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method 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 • use hydrochloric acid • place acid in suitable container eg beaker • add (a spatula of) magnesium carbonate • stir • continue adding magnesium carbonate until in excess • when solid remains **or** no more effervescence occurs • filter to remove excess magnesium carbonate • using filter paper and funnel • pour solution into evaporating dish • evaporate water till crystallisation point reached • using electric heater or Bunsen burner and a water bath • leave to cool • until crystals form • pour off excess water **or** filter • dry crystals in cool oven or with filter paper			
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ (×100)	allow efficiency = $\frac{\text{useful output}}{\text{total input}}$ (× 100)	1	AO1 4.8.2.7
03.2		an answer of 0.92 or 92 (%) scores **2** marks		AO2 4.8.2.7
	(efficiency =) $\frac{1.2 \times 10^{18}}{1.3 \times 10^{18}}$ (× 100)		1	
	= 0.92 **or** 92 (%)	allow an answer that rounds to 0.92 **or** 92 (%) ignore units	1	
03.3	at a high potential difference and a low current		1	AO1 4.7.2.9
03.4	power = $\frac{\text{energy transferred}}{\text{time}}$	allow $P = \frac{E}{t}$	1	AO1 4.7.2.7
03.5		an answer of 9 600 000 (kJ) scores **3** marks		AO2 4.7.2.7
	$8000 = \frac{E}{1200}$	if a conversion of 8000 has been attempted, this mark can be awarded	1	
	(E =) 1200 × 8000	if a conversion of 8000 has been attempted, this mark can be awarded	1	
	(E =) 9 600 000 (kJ)	this answer only	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	any **four** from: (environmental advantages) • renewable / sustainable (energy source) • conserves fossil fuels • no release of pollutant gases eg sulfur dioxide • no release of greenhouse gases • does not contribute to global warming (environmental disadvantages) • noise pollution • visual pollution • bird kill • not always windy so more use of fossil fuel power stations	**max 3** marks if only refers to advantages or disadvantages ignore references to cost allow does not release carbon dioxide ignore destruction of habitat	4	AO1 AO3 4.8.2.4
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	continuous field lines that start and finish on the poles direction of arrow from North to South	the diagram:  scores **2** marks	1 1	AO1 4.6.3.2

04.2	**Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO1 4.6.3.2
	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 • place the magnet on a piece of paper • draw around the magnet • mark north and south poles • place the compass by a pole of the magnet • make a dot at the tip of the compass needle • move the compass tail to the new dot • make a dot at the tip • repeat until the compass reaches the other pole of the magnet • draw a line through the dots • add arrow to show direction of field line (from north to south) • repeat for different starting positions at the poles		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	compass needle is a (small bar) magnet (so) the compass / needle and bar magnet exert a force on each other **or** (so) the compass / needle is attracted / repelled by the bar magnet		1 1	AO1 4.6.3.1 4.6.3.2 4.6.3.3
04.4	cobalt		1	AO1 4.6.3.2
04.5	(magnetic north / south) poles are changing position direction of magnetic field has reversed	allow reference to compass needle changing direction (over time) allow magnetic patterns in rocks (at constructive plate boundaries) allow changing migration patterns of birds / animals	1 1	AO1 4.6.3.3
04.6	(molten) iron moving in (Earth's outer) core		1 1	AO1 4.6.3.3
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	reference to glow		1	AO3 4.7.3.3
	(which) shows energy is being transferred to the surroundings	allow 'heat' for energy allow (which) shows energy is being given out	1	AO1 4.7.3.3
05.2		an answer of 1.27 (g) scores **3** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.5.2.5
	(M_r CuO =) 79.5		1	
	$\left(\text{moles copper oxide} = \frac{\text{mass}}{M_r}\right.$ $= \frac{1.59}{79.5}\left.\right) = 0.02$	allow an incorrectly calculated value for M_r from step 1	1	
	(mass Cu = 0.02 × 63.5) = 1.27 (g)		1	
		alternative approach: 79.5 (g) CuO → 63.5 (g) Cu (1) (mass Cu =) $\frac{63.5}{79.5}$ × 1.59 (1) (mass Cu) = 1.27 (g) (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	hydrochloric acid reacts with zinc oxide	allow hydrochloric acid and zinc oxide produce zinc chloride	1	AO2 4.7.3.2 4.7.5.1
	(to) form a solution (of zinc chloride)		1	AO2 4.7.3.2 4.7.5.1
	copper does not react (with dilute acid)		1	AO1 4.7.3.2 4.7.5.1
	(so copper) remains as a solid	allow (so copper) will collect in filter paper	1	AO2 4.7.3.2 4.7.5.1
05.4	zinc has been oxidised because the zinc atoms have lost electrons		1	AO2 4.7.5.5
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	bioleaching		1	AO1 4.8.2.3
	bacteria	dependent on bioleaching being given	1	
	phytomining		1	
	plants	dependent on phytomining being given	1	
06.2	any **three** from: • copper ores are becoming scarce • can extract from low grade ores • mining not required • moving / disposing of large amounts of rock not required	ignore references to cost allow extraction of copper from contaminated land allow consequences of less mining allow less energy required allow fewer emissions of greenhouse gases **or** less carbon dioxide released allow reduces global warming	3	AO1 4.8.2.3
06.3	iron is more reactive than copper		1	AO1 4.7.5.1
	(so) iron displaces copper (from copper sulfate)	allow (so) iron reduces copper ions	1	AO2 4.7.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	correct formulae and symbols	equation must be correctly balanced	1	AO2 4.5.2.1
	correct state symbols	allow for **2** marks $Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$	1	
06.5		an answer of 3.01×10^{22} (ions) scores **4** marks answer not given in standard form **max 3** marks		AO2 4.5.2.4
	(moles copper ions) = $\frac{3.175}{63.5}$		1	
	= 0.05 (moles)		1	
	(number of copper ions = moles × Avogadro constant) $= 0.05 \times 6.02 \times 10^{23}$	allow incorrectly calculated value for number of moles from step 2	1	
	$= 3.01 \times 10^{22}$ (ions)		1	
Total			**15**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	all points correct	allow a tolerance of ± half a small square allow **1** mark if 3 **or** 4 points are correct	2	AO2 4.7.3.3
	line of best fit (0–20 cm^3 hydrochloric acid added)		1	
	extrapolation of both lines to cross		1	
07.2	correct value determined from their drawn lines of best fit	allow a tolerance of ± half a small square	1	AO3 4.7.3.3
07.3	1×10^{-2} °C		1	AO2 4.7.3.3
07.4	any **two** from: • repeat the experiment **and** calculate the mean • use a lid • insulate the polystyrene cup • measure sodium hydroxide with a pipette / burette • use smaller intervals for addition of hydrochloric acid	allow add hydrochloric acid in intervals of 1 or 2 cm^3 allow record temperature when 25 cm^3 of hydrochloric acid is added	2	AO3 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	any **six** from: • pH at start is 13 / 14 • because sodium hydroxide is an alkaline solution as it contains OH^- ions • as hydrochloric acid added the pH decreases • because the H^+ ions react with OH^- ions • this is a neutralisation reaction • when (excess) hydrochloric acid added, H^+ ion concentration increases • as H^+ ion concentration increases by a factor of 10, the pH value decreases by 1 • when excess hydrochloric acid added, pH is 0 / 1	ignore reference to indicator colours allow values between 8–14 allow pH values between 0–6	6	AO1 AO2 4.7.3.4 4.7.3.5
07.6	(concentration =) $1.4 \times \frac{1000}{25}$ = 56 (g/dm^3)	an answer of 56 (g/dm^3) scores **2** marks allow a correctly calculated answer from an incorrect attempt at volume conversion an answer of 0.056 (g/dm^3) scores **1** mark	1 1	AO2 4.5.2.6
Total			**16**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	air resistance	allow drag ignore wind resistance	1	AO1 4.6.1.1 4.7.1.4
08.2	B–C		1	AO2 4.7.1.4 4.7.1.5
08.3		an answer of 1160 (kg m/s) scores **3** marks		AO2 4.7.1.8
	(velocity =) 12.2 (m/s)		1	
	(momentum =) 94.8 × 12.2		1	
	(momentum =) 1160 (kg m/s)	allow an answer that rounds to 1160 (kg m/s) an answer of 1147 / 1150 scores **2** marks	1	
08.4	tangent drawn at 12 s		1	AO2 4.7.1.4
	correct readings of Δv and Δt from tangent		1	AO2 4.7.1.4
	$\text{(acceleration)} = \frac{\text{their value of } \Delta v}{\text{their value of } \Delta t}$		1	AO2 4.7.1.4
	$-2.4\ (m/s^2)$	allow value in range -2.2 to $-2.6\ (m/s^2)$ allow a correctly calculated answer from $-\frac{\text{their value of } \Delta v}{\text{their value of } \Delta t}$	1	AO2 4.7.1.4
	m/s^2	allow m/s/s	1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	straight line (with gradient of 1.6) from origin to 6 s, 9.6 m/s	allow **1** mark for a straight line below A–B with a positive gradient from origin to 6 s	2	AO2 4.7.1.4
08.6	(calculation of distance travelled by first athlete) (2.2 × 12.2) = 26.84 (m) (0.5 × 3.8 × 12.2) = 23.18 (m)	an answer of 21.22 (m) scores **4** marks an answer of 50.02 (m) scores **2** marks	1 1	AO2 4.7.1.4
	(calculation of distance travelled by second athlete) (0.5 × 9.6 × 6 =) 28.8 (m)	allow ecf from question **08.5** allow (9.6^2 − 0 = 2 × 1.6 × s =) 28.8 (m)	1	
	(calculate difference) = 21.22 (m)	allow their distance for athlete 1 minus their distance for athlete 2	1	
Total			**16**	