



GCSE COMBINED SCIENCE: SYNERGY 8465/4F

Foundation Tier Paper 4 Physical Sciences

Mark scheme

June 2025

Version: 1.0 Final



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

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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 **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	the energy resource can be replenished		1	AO1 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(22 + 18 + 10 + 7 + 3 =) 60		1	AO2 4.8.2.4
	percentage = 40 (%)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$E = 200\,000 \times 300$		1	AO2 4.7.2.7
	$E = 60\,000\,000 \text{ (J)}$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	wind turbines do not burn fuel to produce electricity		1	AO3 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	biofuel		1	AO1 4.8.2.4
	gas		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	global warming or climate change	allow melting ice-caps allow sea level rising	1	AO1 4.8.2.4
Total Question 1			9	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	metre rule		1	AO3 4.7.1.6 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	0.001 s		1	AO3 4.7.1.6 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	2.18 (m/s) to 2.32 (m/s)	either order	1	AO3 4.7.1.6 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	acceleration = $\frac{(2.24)^2}{(2 \times 0.98)}$		1	AO2 4.7.1.6 RPA14
	acceleration = 2.56 (m/s ²)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	the line should pass through the origin		1	AO1 4.7.1.6 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	correct pair of values read from graph		1	AO2 4.7.1.6 RPA14
	gradient = 5.0	ignore any unit given	1	
Total Question 2			8	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	oxygen	allow O ₂	1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	copper can be shaped		1	AO2 4.6.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(number of carbon atoms) 4	allow correct use of an incorrectly determined number of carbon / hydrogen atoms	1	AO2 4.6.2.4
	(number of hydrogen atoms) 10		1	
	(simplest ratio, C : H =) 2 : 5		1	
	C ₂ H ₅	allow correct use of an incorrectly determined simplest ratio	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	covalent		1	AO1 4.6.2.4 4.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	small molecule		1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	propane		1	AO3 4.6.2.5

Total Question 3	9
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Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	the elastic potential energy decreases		1	AO1 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the kinetic energy increases		1	AO1 4.7.1.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	conserved		1	AO1 4.8.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	work done = 8.0×0.25	allow J	1	AO2
	work done = 2.0		1	AO2
	joules		1	AO1
				4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	5 correctly plotted points	allow a tolerance of $\pm \frac{1}{2}$ a small square allow 1 mark for 3 or 4 correctly plotted points	2	AO2 4.7.1.2
	straight line of best fit		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	increases		1	AO3 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	increase the launch speed of the aeroplane		1	AO3 4.7.1.5
	make the aeroplane more streamlined		1	
Total Question 4			12	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	cooler		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	condensing		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	increases		1	AO1 4.6.2.5 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	decreases		1	AO1 4.6.2.5 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(in heavy fuel oil) the molecules are larger	allow (in heavy fuel oil) there are more carbon atoms in a molecule	1	AO3 4.8.1.3 4.8.1.4
	(heavy fuel oil) has a higher supply than demand		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	polymerisation		1	AO1 4.8.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	the same number of bottles are needed		1	AO3 4.8.2.8
	(but) plastic bottles have a lower mass	(but) plastic bottles are lighter	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	any two from: • recycle • reuse • use compostable plastic bottle • pay a deposit on the bottle • repurpose		2	AO3 4.8.2.8 4.8.2.9

Total Question 5	11
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Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	Level 3: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.7.2.2 RPA15
	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 • close the switch • measure potential difference and current • measure the current using the ammeter • measure the potential difference using the voltmeter • method to vary potential difference and current eg vary variable resistor, variable power pack or vary the number of cells • take several readings of potential difference and current • measure potential difference up to 6.0 V • use an interval for potential difference of 1.0 V • repeat with reversed power supply terminals to obtain negative values		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	the resistance of the filament lamp increases		1	AO1 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	Component Diode Resistor at constant temperature do not accept more than one line drawn from a box on the left	Graph	1 1	AO1 4.7.2.2 RPA15
Total Question 6			9	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	$\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$	allow multiples	1	AO2 4.5.2.1 4.5.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	surface area of magnesium		1	AO2 4.7.4.1 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	to reduce loss of hydrogen	allow to reduce loss of gas do not accept to stop loss of hydrogen / gas	1	AO3 4.7.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(volume of gas = $47 - 23 =$) 24 (cm ³)	allow correct use of an incorrectly determined volume and/or time taken	1	AO2
	(time taken = $60 - 20 =$) 40 (s)		1	AO2
	(mean rate of reaction =) $\frac{24}{40}$		1	AO2
	= 0.6		1	AO2
	cm ³ /s		1	AO1 4.7.4.1 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(the volume of gas collected) remains constant		1	AO3 4.7.4.1
	(because) the reaction has finished	allow the magnesium / acid / reactants have been used up	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	line starting at 0,0 which is initially steeper than the existing line		1	AO3 4.7.4.1 4.7.4.2
	then becomes level at 50 cm ³	allow a tolerance of $\pm \frac{1}{2}$ a small square	1	

Total Question 7	12
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Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	as force increases, extension increases		1	AO3 4.6.1.6 RPA13
	in a linear relationship	allow in a straight line allow 2 marks for force and extension are (directly) proportional	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	spring C		1	AO3 4.6.1.6 RPA13
	smallest extension for the same force or lowest gradient	MP2 dependent on MP1 allow correct calculations of all three spring constants	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	$75.6 = 0.5 \times k \times 0.60^2$		1	AO2
	$k = \frac{75.6}{0.5 \times 0.60^2}$		1	AO2
	$k = 420$		1	AO2
	N/m		1	AO1 4.6.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	work done is equal to elastic potential energy stored		1	AO1 4.6.1.6

Total Question 8	9
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Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	other pH values are also green	allow pH 6 / 8 is also green	1	AO3 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	pH probe	allow pH meter / sensor	1	AO3 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	neutralisation	allow exothermic	1	AO1 4.7.3.2 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	$(M_r =)$ $1 + 14 + (16 \times 3)$ $= 63$		1	AO2 4.5.2.3
			1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	OH ⁻		1	AO1 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	(conversion $5 \text{ cm}^3 \Rightarrow 0.005 \text{ dm}^3$)		1	AO2 4.5.2.6
	(mass $\Rightarrow 5.6 \times 0.005$)	allow correct use of incorrect / no conversion of volume	1	
	$= 0.028 \text{ (g)}$		1	
	alternative approach:			
	(conversion $5.6 \text{ g/dm}^3 \Rightarrow 0.0056 \text{ g/cm}^3$ (1))			
	(mass $\Rightarrow 0.0056 \times 5$ (1))	allow correct use of incorrect / no conversion of concentration		
$= 0.028 \text{ (g)}$ (1)				
Total Question 9			9	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	power input to 1 m ² = $\frac{468\,000}{720}$		1	AO2 4.8.2.4
	power input to 1 m ² = 650 (W)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.8.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	$0.20 = \frac{\text{useful power output}}{250\,000}$		1	AO2 4.8.2.7
	useful power output = $0.20 \times 250\,000$		1	
	useful power output = 50 000 (W)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	0:00 to 06:00 and 16:00 to 0:00		1	AO3 4.8.2.4
	time = 14 (hours)		1	

Question	Answers	Mark	AO / Spec. Ref.
10.5	Level 2: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.8.2.4 4.7.2.9
	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 • solar panels do not generate electricity at night • battery provides power at night • power from solar panels can recharge the battery when power demand is less than power output • power demand is greater than power output between 16:00 and 06:00 • (so) battery provides power between 16:00 and 06:00 • power demand is less than power output between 06:00 and 16:00 • (so) power from solar panels can recharge the battery between 06:00 and 16:00 To get into Level 2, answers must show use of data from the graph.		

Total Question 10	12
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