



GCSE COMBINED SCIENCE: SYNERGY 8465/2H

Higher Tier Paper 2 Life and Environmental 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](https://www.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 © 2025 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 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 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	<i>substitution</i> $400 = \frac{38}{\text{size of real object}}$	allow real diameter for size of real object	1	AO2 4.1.3.1
	<i>rearrangement</i> $\text{size of real object} = \frac{38}{400}$	allow substitution of incorrectly converted value	1	
	0.095 (mm)	allow answer of incorrectly converted value	1	
	<i>conversion</i> (0.095 × 1000 =) 95 (micrometres)	allow conversion to µm at any stage	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	shape similar to cell in Figure 1 and nucleus is present	ignore shading ignore drawing of zona pellucida	1	AO2
	any two features correctly labelled: • cell membrane • cytoplasm • nucleus	allow label line to zona pellucida do not accept cell wall do not accept other cellular structures drawn	1	AO1 4.1.3.1 4.1.3.2 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	any one from: • mitochondria • ribosome	ignore vacuole unqualified do not accept permanent vacuole	1	AO2 4.1.3.1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	meiosis		1	AO1 4.1.3.5 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	23	do not accept 23 <u>pairs</u>	1	AO1 4.1.3.5 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	sperm contain either an X or a Y (chromosome)	do not accept a sperm contains X and Y chromosomes	1	AO1 4.4.3.2
	sperm with X (chromosome) result in female offspring or sperm with Y (chromosome) results in male offspring		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	LH		1	AO1 4.3.1.6

Question	Answers	Mark	AO / Spec. Ref.
01.8	Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.3.1.7
	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	
	Indicative content effectiveness in perfect use - pill and sterilisation expected to be equally effective - pill / sterilisation expected to be most effective - condom expected to be least effective - condom (approximately) 1% less effective than pill / sterilisation effectiveness with use in real life - condom is least effective in real life - sterilisation is most effective or more effective than the pill / condom - pill is more effective than the condom - condom shows 6% difference to the pill - condom shows 12% difference to the sterilisation - pill shows 6% difference to the sterilisation difference in effectiveness between perfect use and use in real life - condom less effective in real life than with perfect use - pill less effective in real life than with perfect use - male sterilisation no difference - condom shows greatest difference between perfect and real use - condom shows 11% difference between perfect and real use - pill shows 6% difference between perfect and real use reasons for differences and other considerations - condoms splitting - forgetting to take pill - food poisoning affecting effectiveness of pill - only condom protects against sexually transmitted diseases - surgical sterilisation is (generally) permanent For Level 3, answers must compare the effectiveness of all three methods and must include use of comparative data.		

Total Question 1	18
-------------------------	-----------

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	measuring cylinder	allow burette allow volumetric beaker / flask	1	AO3 4.1.4.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	thermometer A can measure smaller temperature changes	allow thermometer A has a better resolution allow thermometer A is more accurate	1	AO3 4.1.4.3 RPA6
	thermometer A is easier to read or no parallax error when taking readings using thermometer A	allow thermometer B is more difficult to take readings from ignore thermometer A is digital	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	cans had different start temperatures		1	AO3 4.1.4.3 RPA6
	(so) two variables were being changed or start temperature and colour of can was being changed or initial temperature should be a control variable or water temperature affects rate of infrared emission	ignore no repeat readings	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	the datalogger recorded readings more frequently than a student could		1	AO3 4.1.4.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	at the start of the investigation		1	AO3 4.1.4.3 RPA6
	temperature changes most quickly or gradient of line is greatest	MP2 dependent on MP1 allow temperature difference between can and surroundings is greatest allow temperature (of can) is greatest	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	line starting at 80 °C, above existing line and similar curved shape	ignore any part of line drawn beyond 5 minutes	1	AO3 4.1.4.3 RPA6

Total Question 2	9
-------------------------	----------

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	heat / boil (sea) water	allow steam for water vapour	1	AO1 4.4.1.8 RPA11
	(so) water vapour is produced	allow water turns into a gas	1	
	cool the water vapour	allow description of a method to cool the (water) vapour	1	
	(so) water (vapour) condenses		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	measure the boiling point (using a thermometer)		1	AO1 4.1.1.5 RPA11
	(pure water) boils at a specific temperature	allow (pure water) boils at (exactly) 100 °C	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	any two from:	ignore references to size and scale	2	AO1 4.1.1.1
	• there are no forces shown (between the molecules / particles)	ignore references to bonds		
	• molecules / particles are not two dimensional	allow molecules / particles are 3D		
	• molecules / particles are not inelastic spheres			
	• does not show (molecule / particle) movement	allow molecules / particles will be vibrating / moving		
	• molecules / particles are not solid (spheres)	allow molecules / particles are mostly empty space		

Total Question 3	8
-------------------------	----------

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$6\text{CO}_2 + 6\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	allow multiples if no marks awarded allow 1 mark for identifying (reactants) $\text{CO}_2 + \text{H}_2\text{O}$ and (products) $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$ ignore light / energy	2	AO1 4.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	any two pairs from: control length of plant / species (1) (because) greater surface area will absorb more light (1) OR control temperature (1) (because) higher temperature would increase (rate of) photosynthesis (to a point) (1) OR use a measuring cylinder to collect bubbles / oxygen (1) (because) bubbles may be different volumes / sizes (1) OR use at least 5 different distances (1) (so) patterns can be seen in the results (1) OR replace water between each species / repeat / distance (1) (because) plants use up carbon dioxide (in the water) therefore reducing (rate of) photosynthesis (for next plant / species / distance) (1)	allow control surface area (of plant / species) allow greater surface area would increase the rate of photosynthesis allow use an LED bulb / lamp allow add heat sink allow add beaker of water (between of lamp and plant) allow description of heat sink allow use a (gas) syringe allow (so) volume of gas / oxygen is measured accurately allow replace water with sodium hydrogen carbonate solution allow (so) carbon dioxide is not limiting	4	AO2 AO3 4.2.2.6 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	<i>substitution</i> light intensity = $\frac{1}{(60)^2}$		1	AO2 4.2.2.6 RPA10
	= 0.000278		1	
	<i>number of times greater</i> $\frac{0.0025}{0.000278}$	allow correct substitution using calculated value of light intensity at 60cm	1	
	= 9	allow 8.9928... correctly rounded to 1 or more significant figures allow a correct calculation using calculated value of light intensity at 60 cm	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	extrapolation line on Figure 8 (for species B)		1	AO2
	reading from extrapolated line at 10 cm	allow a tolerance of $\pm \frac{1}{2}$ a small square	1	AO3
		if there is no extrapolation of the curve allow answers in the range 155 to 175 for 1 mark		4.2.2.6 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	C (because) at higher light intensities, plant (C) is photosynthesising the most	MP2 dependent on MP1 allow at smallest distance from light, plant (C) is photosynthesising most ignore number of bubbles	1	AO3 4.2.2.6 RPA10
			1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	any one from: • soot / carbon • dust		1	AO1 4.4.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(global dimming causes) lower light (intensity) so causes lower rate of photosynthesis (so) less glucose produced (so) less protein / cellulose for growth or (so) fewer amino acids for growth		1	AO2 4.2.2.5 4.2.2.6 4.4.1.6
			1	
			1	

Total Question 4	18
-------------------------	-----------

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(in CHD) fatty material builds up in the (coronary) arteries	allow plaques form in (coronary) arteries	1	AO1
	(therefore) less blood flow to heart muscle		1	AO1
	(therefore) less oxygen / glucose to heart muscle cells		1	AO2
	(therefore) less (rate of) respiration	allow increased <u>anaerobic</u> respiration	1	AO2
	(therefore) less energy release for (heart) muscle <u>contraction</u>	do not accept energy produced / made / created	1	AO2
	(therefore) less blood flow and therefore less oxygen / glucose to muscles in the rest of body (for movement / running)		1	AO2 4.2.1.1 4.2.1.3 4.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	any one from:		1	AO3 4.1.3.4 4.1.3.6
	- stem cells have to go through mitosis - stem cells take time to differentiate / specialise	allow stem cells have to divide allow stem cells take time to form heart muscle cells		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(stem cells from patient) will not be rejected	allow stem cells from a donor might be rejected	1	AO3 4.3.3.8 4.3.3.9
	by the immune system	allow because the tissues will match ignore references to availability of stem cells from a donor	1	
Total Question 5			9	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	all electromagnetic waves have the same speed in a vacuum		1	AO1 4.1.4.3
	all electromagnetic waves transfer energy		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	C		1	AO3 4.1.4.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$f = 2\,400\,000\,000$ (Hz) or $f = 2.4 \times 10^9$ (Hz)	all subsequent marks can score using an incorrectly / not converted value of f	1	AO2 4.1.4.2
	$3 \times 10^8 = 2.4 \times 10^9 \times \lambda$		1	
	$\lambda = \frac{3 \times 10^8}{2.4 \times 10^9}$		1	
	$\lambda = 0.125$ (m)	allow an answer of 0.13 (m)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	the radio waves induce oscillations in the aerial	allow the radio waves cause electrons (in the aerial) to oscillate	1	AO1 4.1.4.4
	(which causes an) alternating current with the same frequency as the radio waves		1	

Total Question 6	9
-------------------------	----------

Question 7

Question	Answers	Mark	AO / Spec. Ref.
07.1	Level 2: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO2
	Level 1: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1–2	AO1
	No relevant content	0	4.4.1.4 4.4.1.5
	Indicative content How predictions can be made - analysis of data to determine trends - about concentrations of gases in the atmosphere over time - about climate over time - extrapolation of the trends into the future - use of computer models Future climate is difficult to predict - because future emissions are difficult to predict - because future carbon dioxide or methane levels are only predictions - because many factors impact climate - because there are complex interactions between the factors (that affect climate change) - because more non-renewable energy resources may be used in the future - because of new technologies being developed - because future mitigations or legislations are difficult to predict - because data may not be available from all areas of the world		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	more water vapour (in the atmosphere)		1	AO3
	(since) water vapour is a greenhouse gas		1	AO3
	(which) allows short-wavelength radiation to pass through (from the Sun)	allow greenhouse gases let short-wavelength radiation pass through (from the Sun)	1	AO2
		allow ultraviolet / UV for short-wavelength radiation		
	(but water vapour) absorbs outgoing long-wavelength radiation (from the Earth's surface)	allow visible light for short-wavelength radiation		
		allow greenhouse gases absorb outgoing long-wavelength radiation (from the Earth's surface)	1	AO2
		allow infrared / IR for long-wavelength radiation		4.4.1.3 4.4.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(number of times greater =) $\frac{1.9}{7.1 \times 10^{-4}}$	allow $\frac{1.9}{0.00071}$	1	AO2 4.4.1.3
	= 2676.056...		1	
	= 2700	allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses concentration values from Table 2	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	carbon dioxide has highest concentration in the atmosphere or the relative greenhouse effect multiplied by the concentration is greatest for carbon dioxide		1	AO3 4.4.1.3 4.4.1.5

Total Question 7	12
-------------------------	-----------

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	select fruit flies with the longest and roundest wings and breed (selected flies together)	ignore with desired genes	1	AO2
	select offspring with the longest and roundest wings and (only) allow these to breed	allow select flies with the desired characteristics and allow to breed	1	AO1
	repeat (over many generations) until all flies have long and round wings	do not accept idea of repeating with the same parents	1	AO2 4.4.4.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	<u>natural selection</u> occurred		1	AO2
	(because) there is an advantage to having short wings	allow (because) there is a disadvantage to having long wings	1	AO3
	such as (short wings) need less food / resources / energy	allow such as (short wings) easier / faster to escape predators	1	AO3
	OR the allele(s) for short wings still present (in the population) (1) could be an advantage to have short wings (1) (so) <u>natural selection</u> occurred (until all fruit flies had short wings) (1)	allow such as (short wings) faster to mature / grow ignore reference to dominant and recessive alleles		4.4.4.2 4.4.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	genus (name)	ignore first word / name / part	1	AO1 4.4.4.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	enzyme(s)		1	AO1 4.4.4.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	GM flies breed with wild flies and the offspring will be male		1	AO2 4.4.2.2 4.4.4.6
	(then) if many more males than females (in population) it is less likely that fruit flies find a female / mate	allow if many more males than females (in population) there will be more competition to find a female / mate	1	
	(so) reproduction rate will be lower	if no other mark awarded allow 1 mark for GM fruit flies out compete wild fruit flies for food	1	

Question	Answers	Mark	AO / Spec.
08.6	Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	4.4.4.6
	Indicative content benefits • (lower population of fruit flies) so less damage to crops ○ (so) more food or increased crop yield ○ human population is growing, therefore more food is required • no / less need to spray pesticides ○ which (may) remain on food and harm humans ○ which (may) harm other (beneficial) insects ○ which (may) harm other plants risks • may be other / unknown effects of GM on wild population (of fruit flies or other species) ○ unknown characteristic of fruit flies that may evolve ○ may decrease population of predators of fruit flies ○ may decrease population of pollinators (in the wild) ○ may decrease biodiversity ○ modified gene may spread to other insects / organisms For Level 3, answers must explain a benefit and a risk.		

Total Question 8**17**