



GCSE COMBINED SCIENCE: SYNERGY 8465/1H

Higher Tier Paper 1 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

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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 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	any one from: - temperature - water (content of the body / blood)	allow pH allow ions / salt allow carbon dioxide allow oxygen allow blood pressure	1	AO1 4.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	7.8 – 4.0		1	AO2 4.3.1.5
	3.8 (arbitrary units)	allow a correct calculation using an incorrect reading of the peak value	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	all points (from 70 minutes to 120 minutes) plotted correctly	allow a tolerance of $\pm \frac{1}{2}$ small square allow 1 mark for 4 or 5 correct plots	2	AO2 4.3.1.5
	curved line of best fit drawn through points	ignore line extended beyond 120 minutes ignore line joined point to point with straight lines	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(pancreas releases / produces) insulin	do not accept glucose is broken down to glycogen	1	AO1 4.3.1.5
	glucose moves from blood to muscle / liver / cells or glucose is converted to glycogen (in muscles / liver)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	glycogen		1	AO1 4.3.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(more) exercise	allow example of (more) exercise	1	AO1 4.3.1.5
	eat less carbohydrate / sugar or eat a low carbohydrate diet	allow eat less fat allow eat a carbohydrate controlled diet allow correct drug treatment eg metformin ignore insulin (injection) ignore references to healthy / balanced diet or diet unqualified if no other marks awarded allow 1 mark for lose weight or maintain healthy weight or eat less or eat fewer calories	1	

Total Question 1	11
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Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(number of electrons) 79		1	AO2 4.1.2.3 4.1.2.4
	(number of neutrons) 118		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	two neutrons and two protons	allow the nucleus of a helium atom ignore symbols representing an alpha particle	1	AO1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(total number of alpha particles = 132 000 + 40 500 + 196 =) 172 696		1	AO2 4.1.2.1
	(percentage =) $\frac{196}{172\,696} \times 100$	all subsequent marks may be awarded using an incorrectly determined total number of alpha particles	1	
	= 0.113 (%)	allow 0.11349... correctly rounded to 2 or more significant figures	1	

Question	Answers	Mark	AO / Spec. Ref.
02.4	Observation Most alpha particles passed straight through the gold foil Some alpha particles changed direction Conclusion Atoms have a charged nucleus Atoms are mostly empty space Atoms contain neutral sub-atomic particles The mass of electrons is less than the mass of atoms do not accept more than one line from a box on the left	1 1	AO1 4.1.2.1
Total Question 2		8	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	the mutation could stop cells producing a protein		1	AO2 4.4.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(white lions are) less camouflaged	allow white colour may lead to rejection (by other lions) allow more likely to be seen by prey / predators	1	AO2 4.4.2.1 4.4.4.2
	(so) less likely to catch food	allow (so) more likely to be shot / hunted / captured / attacked / killed	1	
	(so) less likely to (survive and) breed / reproduce or (so) less likely to pass on allele for white fur	allow fewer white lions to breed / reproduce ignore (so) less likely to survive unqualified	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(parents gamete genotypes shown)	if neither mark awarded allow 1 mark for parent gamete genotypes reversed	1	AO2
	(heterozygous male) B b			
	(homozygous recessive female) b b		1	AO2
	(possible offspring genotypes correctly derived) Bb Bb bb bb	allow correct derivation of offspring genotypes from incorrect gametes allow 3 correct offspring genotypes for 1 mark	2	AO2
	correct identification of: Bb as brown and bb as white	if derivation not correct and shows BB and Bb , both must be identified as brown	1	AO2
	probability must match derived offspring genotypes	allow correct probability from incorrectly derived offspring if no derivation shown allow 0.5 or 50% or 1 in 2 or 1:1 or ½ do not accept 1:2	1	AO3 4.4.3.3 4.4.3.4

Total Question 3	10
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Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(similarity) same number of protons	allow atomic number	1	AO1 4.1.2.4
	(difference) number of neutrons	allow mass number	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(alpha) can pass through a few mm / cm of air (before being stopped)	allow stopped / absorbed by paper allow stopped / absorbed by a few mm / cm of air allow stopped / absorbed by skin	1	AO1 4.3.2.4
	(beta) can pass through air / paper	allow stopped / absorbed by thin (sheets of) metal allow stopped / absorbed by a few metres of air	1	
	(gamma) can pass through most materials	allow reduced / stopped / absorbed by thick lead allow reduced / stopped / absorbed by several metres of concrete if no other mark awarded allow 1 mark for alpha is less penetrating than beta which is less penetrating than gamma	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$^{137}_{56}\text{Ba} + ^0_{-1}\text{e}$	allow 1 mark for 137 and 0 in correct positions allow 1 mark for 56 and -1 in correct positions if no other marks scored allow 1 mark for correct numbers for electron	2	AO1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	the time it takes for the number of nuclei (of the isotope in a sample) to halve or the time it takes for the count rate (from a sample of the isotope) to halve	allow the time it takes for the activity (of a sample of the isotope) to halve allow time taken for half the nuclei (in a sample of the isotope) to decay	1	AO1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	for iodine many half-lives passed	if neither mark awarded allow 1 mark for the half-life of iodine is much less than the half-life of caesium	1	AO2
	for caesium less than one half-life passed		1	AO2
	(so the) risk from iodine decreased by a large amount		1	AO3
	or	allow in 2024 the risk from iodine was much less than the risk from caesium if no other marks awarded allow 1 mark for the risk from both isotopes has decreased	1	AO3 4.3.2.6 4.3.2.3
	(so the) risk from iodine decreased to (almost) zero			
	(and the) risk from caesium decreased slightly			
or				
(and the) risk from caesium is still (quite) high				
Total Question 4			12	

Question 5

Question	Answers	Mark	AO / Spec. Ref.
05.1	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	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content identify hormones • X oestrogen • Y LH or luteinising hormone • Z progesterone Oestrogen • peak before FSH / LH or peaks before ovulation • because oestrogen stimulates LH release / production • inhibits the release / production of FSH • (second) peak in second half of cycle or after ovulation • because builds / maintains uterus lining LH • inhibits oestrogen release / production • peaks just before ovulation • because LH stimulates ovulation Progesterone • peaks in second half of cycle or after ovulation • because maintains uterus lining • inhibits LH and FSH release / production For Level 3, evidence for identification of hormones given and all hormones identified.		4.3.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$\frac{265 - 250}{250} \times 100$	allow $\frac{15}{250} \times 100$	1	AO2 4.3.1.6
	6 (%)	allow $\frac{265 \times 100}{250} - 100$	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any one from: • remain immune to the disease / pathogen (for many years) • may not be exposed to the disease / pathogen for many years • no need for repeated vaccinations		1	AO2 4.3.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	by producing antitoxins		1	AO1 4.3.3.4

Total Question 5	10
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Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the mobile phase is the solvent	allow a named solvent such as water / alcohol	1	AO1 4.2.2.4 RPA9
	the stationary phase is the paper		1	
	each substance is distributed differently between the stationary and mobile phase	allow each substance has a different attraction for the stationary and mobile phase	1	
	(so) substances move up the paper at different speeds / rates	allow each substance has a different solubility in the solvent allow (so) substances move different distances up the paper ignore references to time	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(conversion 8.0 cm $\Rightarrow$) 80 mm		1	AO2 4.2.2.4 RPA9
	$0.30 = \frac{\text{distance moved}}{80}$	allow correct use of an incorrectly converted distance	1	
	(distance moved $\Rightarrow$) 0.30×80		1	
	= 24 (mm)		1	
	alternative approach			
	$0.30 = \frac{\text{distance moved}}{8.0} \quad (1)$			
	(distance moved $\Rightarrow$) 0.30×8.0 (1)			
	= 2.4 (cm) (1)			
	= 24 (mm) (1)	allow correct conversion from an incorrectly determined distance		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	determine the R_f value	allow $R_f \text{ value} = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$ allow description of calculation	1	AO1 4.2.2.4 RPA9
	compare the R_f value with known values (for other substances in that solvent) or repeat with known substances and compare R_f values (for that solvent)		1	

Total Question 6	10
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Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	algae		1	AO1 4.4.2.1 4.4.1.1

Question	Answers	Mark	AO / Spec. Ref.
07.2	Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.4.2.3
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • increased competition for mates ○ so population will decrease • new / increased predators ○ which eat / kill the penguins ○ so population will decrease • prey / fish populations ○ may decrease so penguins have less to eat ○ (less food) so penguin population will decrease ○ may increase so penguins have more to eat ○ (more food) so penguin population will increase • algae decrease ○ due to disease ○ leads to decrease in fish populations ○ so population will decrease • new / increased pathogens / diseases ○ which may kill penguins ○ because they live / nest close together ○ so population will decrease • human interference ○ destroys habitats ○ so population will decrease • habitat loss / competition ○ competition for nesting sites / space ○ competition for stones to make nests ○ so population will decrease For Level 2, answers must consider biotic factors and their effect on the population.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	<i>total area</i> ($2.0 \times 60\,000 =$) $120\,000 \text{ (m}^2\text{)}$	allow π for 3.14 throughout	1	AO2 4.4.2.4
	<i>substitution</i> $120\,000 = 3.14 \times \text{radius}^2$	all subsequent marks may be awarded using an incorrectly calculated total area	1	
	<i>rearrangement</i> $\text{radius} = \sqrt{\frac{120\,000}{3.14}}$	allow $\text{radius}^2 = \frac{120\,000}{3.14}$	1	
	195 (m)	allow 195.49... correctly rounded to 3 or more significant figures allow 195.44... correctly rounded to 3 or more significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	use quadrats to sample abundance	max 3 marks if methods are not clearly linked to abundance and distribution	1	AO1 4.4.2.4 RPA12
	(because) abundance is the number of individuals of a species in an area / habitat		1	
	use transect(s) to sample distribution		1	
	(because) distribution is where the plants are located		1	
Total Question 7			13	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	mitosis		1	AO1 4.2.2.1 4.1.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any one from: - prevents the bacteria moving to other parts of the plant (may) prevent sugars reaching bacteria in the leaves (for bacteria to respire)	allow (may) prevent bacteria accessing sugars (for respiration)	1	AO3 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	sugar made in leaves by photosynthesis	allow glucose for sugar throughout	1	AO1
	(then sugar) is transported / translocated in phloem (to the oranges)	ignore nutrients / food	1	AO1
	(so) blocking the phloem will prevent / reduce the sugar from reaching the oranges / fruit		1	AO2 4.2.2.7 4.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	some parts of the tree / plant do not photosynthesise	allow glucose for sugar throughout	1	AO2 4.2.2.7 4.2.2.5 4.2.1.1
	(photosynthesis does not happen in) roots / stem / flowers		1	
	respiration stops without sugar		1	
	(so) cells / mitochondria cannot release energy	do not accept energy produced / made / created	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	use / spray pesticides	allow use / spray insecticides	1	AO2 4.2.2.8 4.4.4.6
	to kill insects		1	
	OR			
	destroy / burn infected plants (1)			
	to prevent insects moving bacteria between plants (1)			
		allow stop transporting bees / pollinators between farms (1)		
		to prevent insects moving bacteria between trees (1)		
		OR		
		allow cover trees in nets (1)		
		to prevent insects feeding from trees (1)		
		OR		
		allow do not transport trees to other farms (1)		
		to prevent infecting other farms (1)		
		OR		
		grow GM orange trees resistant to bacteria (1)		
		so bacteria cannot infect the trees (1)		
		OR		
		grow GM trees with an insecticide gene (1)		
		to kill insects (1)		

Question	Answers	Mark	AO / Spec. Ref.
08.6	Level 2: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.2.1.5 RPA7
	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 • add fruit juice to Benedict's solution • control volume of fruit juice • control volume of Benedict's solution • heat in a water bath • heat to at least 60 °C • control temperature • control time heated for (allow suggested time) • compare colour to chart or compare colour to known concentration of sugar with Benedict's solution • repeat for each fruit juice		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	orange colour of juice may affect results		1	AO3 4.2.1.5 RPA7
	because positive test for sugars is yellow / orange / red		1	
	OR the student needed to judge the colour (in the test tube) (1)	allow because the result is qualitative allow because the result is not quantitative		
	which is subjective (1)	allow because different students make different judgements allow because students may be colour blind		
Total Question 8			17	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	$E = 63\,000 \text{ (J)}$	all subsequent marks may be awarded using an incorrectly / not converted value of E	1	AO2 4.1.1.4
	$63\,000 = m \times 4200 \times (82 - 22)$		1	
	$m = \frac{63\,000}{(4200 \times 60)}$		1	
	$m = 0.25 \text{ (kg)}$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	the (average) kinetic energy of the molecules increases	allow particles for molecules throughout	1	AO1 4.1.1.3
	(so) the molecules collide with the container walls more frequently	allow 'speed' for 'kinetic energy'	1	
	(and) each molecule exerts a greater force (on the container walls) or (so) the total force exerted is greater (on the container walls)		1	
	(so) the pressure increases	MP4 dependent on scoring MP1, MP2 or MP3	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	internal (energy)	allow thermal (energy)	1	AO1 4.1.1.4

Total Question 9	9
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