
GCSE COMBINED SCIENCE: SYNERGY 8465/2H

Higher Tier Paper 2 Life and Environmental Sciences

Mark scheme

June 2024

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 © 2024 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	(method A) universal indicator (solution / paper)	allow wide range indicator do not accept litmus indicator / paper	1	AO3 4.4.1.8
	(method B) pH meter / probe	ignore datalogger	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	each method gives values to a different resolution		1	AO3 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	reproducible		1	AO3 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	X		1	AO3 4.4.1.6 4.4.1.7 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(river water X is) acidic	MP1 is dependent on question 01.4 being awarded	1	AO3 4.4.1.6 4.4.1.7
	(because) sulfur dioxide turns to (sulfuric) acid in moist air		1	AO2
	(which causes) acid rain	allow (so) acid rain enters rivers ignore rainwater / precipitation enters rivers	1	AO2

Question	Answers	Mark	AO / Spec. Ref.
01.6	Level 2: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.4.1.8
	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 • filter river water • using a funnel and filter paper • to remove suspended solids • measure initial mass of empty evaporating basin • using a balance • measure 50 cm³ of river water • using a measuring cylinder • transfer the river water to the evaporating basin and heat gently • using a Bunsen burner and water bath or using an electric heater • remove from heat when all liquid has evaporated • measure final mass of evaporating basin plus solids • using a balance • subtract initial mass from final mass of evaporating basin		

Total Question 1	12
-------------------------	-----------

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	divide area into grid	allow place tape measures at right angle	1	AO1 4.4.2.4 4.4.2.5
	use random number generator (to produce coordinates)	allow description of obtaining random numbers do not accept throwing quadrats	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(animal) diversity increases		1	AO2 4.4.2.4 4.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	linear	allow a straight line ignore (directly) proportional do not accept a positive correlation	1	AO2 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	more plant species in living grass (than in plastic grass)	allow converse if clearly describing plastic grass allow higher biodiversity in living grass (than in plastic grass)	1	AO2 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	record the number of plants of each species as well as the number of species		1	AO3 4.4.2.4
	repeat using three different transects that cross the two types of grass		1	

Question	Answers	Mark	AO / Spec. Ref.
02.6	Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	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 Plastic grass will decrease biodiversity • blocks light ○ no / fewer producers / plants ○ so fewer consumers / pollinators / decomposers • blocks animal access to surface ○ so worms / insects cannot access food ○ so fewer consumers • plastic / microplastics enter the food chain (in rivers / oceans) ○ so animals in danger of choking on plastics ○ so microplastics may build up in animals (in the food chain) • fewer decomposers because no / less soil ○ so less nutrients in the soil ○ so fewer plant (species) • cannot be recycled so enters landfill ○ (landfill) reduces / destroys habitats ○ increased pollution ○ so increased consequences of pollution Plastic grass may increase biodiversity • different plants may be able to grow (in plastic grass) ○ so more food for consumers ○ so more consumers / pollinators / decomposers • (slow to decompose) so leaves are present for longer ○ so may provide shelter for animals ○ so more (types of) consumers For Level 3, answers must explain different effects of plastic grass on biodiversity.		4.4.2.2 4.4.2.3 4.4.2.5 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	less genetic variation is a greater risk if the ecosystem changes		1	AO1 4.4.2.5

[illegible]

Total Question 2		16
-------------------------	--	-----------

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	microwaves		1	AO1 4.1.4.3
	gamma / γ		1	
	ultraviolet / UV		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	distance is a control variable	allow so a comparison can be made	1	AO1 4.1.4.3
	so the infrared radiation from the heater reaching each thermometer (per second) is the same	allow if the distances were different, a different amount of infrared radiation from the heater would reach each thermometer (per second)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(risk) burns (from heater)		1	AO3
	(precaution) do not touch the heater (while hot)	allow do not get too close to the heater	1	AO3 4.1.4.3
		ignore (heat resistant) gloves		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	the temperature of the black thermometer increased more (quickly)	allow converse if referring to white surface	1	AO3 4.1.4.3 4.1.4.5
	(because) black surfaces are better absorbers of infrared		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5 view with Figure 4	line starting at 20 °C		1	AO3 4.1.4.3
	line with a positive gradient underneath white surface line	dependent on MP1	1	

Total Question 3		11
-------------------------	--	-----------

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	incomplete combustion (of hydrocarbon fuels)	ignore fuels are burnt	1	AO1 4.4.1.6
	in a limited supply of oxygen	allow air for oxygen	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(shape) increased / high surface area for gas exchange or increased / high surface area for oxygen uptake	allow (biconcave shape) gives flexibility to move / squeeze through capillaries	1	AO1 4.2.1.4 4.4.1.6
	(internal cell structure) lack of nucleus so can contain more haemoglobin	allow lack of mitochondria so can contain more haemoglobin	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	97 (%)	allow an answer in the range 96 – 98 (%)	1	AO2 4.4.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4 view with Figure 5	all points plotted correctly	allow a tolerance of $\pm \frac{1}{2}$ a small square allow 3 or 4 plots correct for 1 mark	2	AO2 4.4.1.6
	line of best fit		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	faster heart rate		1	AO2 4.4.1.6
	faster breathing rate	allow out of breath allow deeper breathing allow vomiting / nausea allow confusion / headache / dizziness allow tiredness allow rosy cheeks allow double vision allow loss of consciousness ignore lack of energy	1	AO3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	haemoglobin transports less oxygen	allow red blood cells transport less oxygen do not accept haemoglobin can transport no oxygen do not accept red blood cells can transport no oxygen	1	AO1 4.4.1.6 4.2.1.1
	(so) lower rate of respiration	allow lack of respiration	1	AO2
	(so) brain / heart (muscle cells) release less energy	allow (so) muscles responsible for breathing release less energy ignore less energy released unqualified do not accept less energy is produced / made / created	1	AO2

Total Question 4	13
------------------	----

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	genes		1	AO1 4.3.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	${}_{90}^{234}\text{Th} + {}_2^4\text{He}$	allow 1 mark for ${}_{90}^{234}\text{Th}$ allow 1 mark for ${}_2^4\text{He}$	2	AO1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	bismuth-210:			AO3 4.3.2.3
	one half-life has passed		1	
	number of nuclei is (about) half the original number		1	
	lead-214:			
	(2×24×5=) 240 half-lives have passed		1	
	(so almost) no nuclei remain	dependent on MP2 and MP4	1	
	conclusion (so) there are (many) more bismuth nuclei than lead nuclei (after 5 days)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	440%		1	AO3 4.3.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	alpha radiation/particles cannot penetrate skin		1	AO3 4.3.2.5 4.3.2.7
	(but) uranium miners inhale radon		1	
	(and) alpha radiation is highly ionising (leading to a higher number of cases amongst miners)		1	
Total Question 5			12	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	water enters <u>root hair</u> (cells) by osmosis	allow water enters <u>root hair</u> cells by diffusion through a partially / selectively / semi permeable membrane	1	AO2 4.2.2.2 4.2.2.3 4.1.3.3
		allow water enters <u>root hair</u> (cells) down its concentration gradient		
		allow water enters <u>root hair</u> (cells) because cytoplasm is more concentrated than soil		
		allow water enters <u>root hair</u> (cells) from low concentration (of solutes) to high concentration		
		allow water enters <u>root hair</u> cells from a high(er) water potential in the soil to a low(er) water potential in the cells		
	(water) travels up xylem (to the pepper)		1	
	due to transpiration (stream)	allow due to evaporation from leaves	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	magnification = $\frac{\text{size / width of image}}{\text{size / width of real cell}}$		1	AO1 4.1.3.1
	$32 \times 1000 = 32\,000$	allow conversion from mm to μm at any stage	1	AO2
	$400 = \frac{32\,000}{\text{real width}}$	allow a correct substitution using an incorrectly / not converted value of image size	1	AO2
	$\text{real width} = \frac{32\,000}{400}$	allow a correct rearrangement using an incorrectly / not converted value of image size	1	AO2
	real width = 80 (micrometres)	allow an answer consistent with their incorrectly / not converted value of image size	1	AO2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any one from: - to reduce evaporation - to reduce / slow decay / decomposition	allow to reduce water loss ignore to reduce transpiration allow to reduce growth of bacteria / microorganisms (that cause decay) allow to reduce / slow conversion of sugar(s) / glucose to starch ignore to prevent decay / decomposition	1	AO2 4.1.3.3 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	takes account of different starting masses / thickness	ignore were not all the same size do not accept as a control variable	1	AO3 4.1.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	0.27 (mol/dm ³)		1	AO3 4.1.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	water moves out (of cell / vacuole / pepper) by osmosis	allow water left cells by diffusion through a partially / selectively / / semi permeable membrane	1	AO3 4.1.3.3
	(from) dilute solution in the cell / vacuole / pepper to concentrated solution outside or (from) high(er) concentration of water in the cell / vacuole / pepper to low(er) concentration of water outside	do not accept solute / sugar (solution) moving allow (from) a high(er) water potential in the cell / vacuole / pepper to a low(er) water potential outside allow (from) a low concentration (of sugar) to a high concentration (of sugar) allow (water moves) down its concentration gradient ignore reference to amount of water / sugar do not accept along / across a concentration gradient	1	AO2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	any two from: - cells take in large volume / mass of water (wrinkles / folds) allow cell to expand (without bursting) (wrinkles / folds provide) large(r) surface area for osmosis	allow cells take in large amount of water allow cells store large volume / mass / amount of water allow (wrinkles / folds provide) large(r) surface area for diffusion (of water)	2	AO3 4.1.3.2 4.2.1.2

Total Question 6	15
-------------------------	-----------

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(different) genes code for different proteins		1	AO1 4.4.3.1
	(which) contain different numbers of <u>amino acids</u>		1	AO2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	females have XX chromosomes and males have XY chromosomes		1	AO1 4.4.3.2 4.1.3.5
	eggs all contain (one) X chromosome (due to meiosis)		1	AO2
	50% of sperm have an X chromosome and 50% of sperm have a Y chromosome (due to meiosis)		1	AO2
	which sperm fertilises each / an egg is random but at population level will be (approximately) 50% distribution	allow from correct Punnett square with male parent and female parent clearly identified	1	AO2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	any one from: - may have unknown long-term / side effects - GM may lead to 'designer babies'	allow (many) countries have governments influenced by religious / cultural groups ignore GM might not work	1	AO3 4.4.4.6 4.3.3.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	an enzyme(s) used to cut / damage the (CCR5) gene		1	AO2 4.4.4.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	white blood cell(s)	allow stem cells that produce white blood cells	1	AO2 4.2.1.4 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	antiretroviral		1	AO1 4.3.3.2

Total Question 7		10
------------------	--	----

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(test) add Biuret (reagent / solution)	allow add Biuret A and Biuret B allow add copper sulfate (solution) and potassium / sodium hydroxide (solution)	1	AO1 4.2.1.5
	(colour change from) blue (to) mauve / purple / lilac / pink-purple	allow turquoise for blue	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(spider) bite puts poison / protein into blood		1	AO3 4.2.1.5
	(but most) protease is in the digestive system	allow protease is in the stomach allow protease is in the small intestine allow animals might not produce the specific protease enzyme allow animals might not produce the protease with the correct active site	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	build up of fatty material in coronary arteries	allow build up of cholesterol in coronary arteries	1	AO1 4.3.1.3 4.2.1.3
	(so) decreased flow of blood which carries oxygen (to heart muscle)		1	AO2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	any one from: - heart needs less oxygen so could be transported further (when the drug is used) heart needs less oxygen therefore may allow more time before the heart must be transplanted	allow heart needs less oxygen therefore remains viable for longer	1	AO3 4.3.1.3

Question	Answers	Mark	AO / Spec. Ref.
08.5	Level 2: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3
	Level 1: Some logically linked reasons are given. There may also be a simple judgement.	1–2	AO2
	No relevant content	0	
	Indicative content Advantages - to patients: - could save lives of people having heart attacks - more people can have heart transplants - could allow longer (heart) operations - practicalities: - may be able to keep / farm (funnel-web) spiders for constant supply - may be able to synthesise the drug Disadvantages - may have (as yet) unknown side effects - may be difficult / dangerous / expensive to source from the wild (funnel-web) spiders may escape - spiders may bite / poison people - effect on food chains from removing the spiders (from a remote area) - endangering / extinction of spiders (due to removal) - ethical considerations of poisoning animals in drugs trial - drug trial process is (very) slow For Level 2 answers must include advantage(s) and disadvantages		4.3.1.3 4.3.3.7

Total Question 8		11
-------------------------	--	-----------