GCSE
COMBINED SCIENCE: TRILOGY
8464/B/2H

Biology Paper 2H

Mark scheme

June 2024

Version: 1.0 Final

2 4 6 G 8 4 6 4 / B / 2 H / M S

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 <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

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	Mark	AO / Spec. Ref.
01.1	alga(e) → limpet(s) → crab(s) direction of arrows must be correct	1	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(50 (cm) × 50 (cm) =) 2500 (cm^2)	allow conversion cm to m (50 ÷ 100 =) 0.5 (m)	1	AO2 4.7.2.1 RPA7
	$(\frac{2500}{100 \times 100}$ =) 0.25 (m^2)	allow ¼ (m^2)	1	
		allow (0.5 × 0.5 =) 0.25 (m^2) for **2** marks		
		allow (½ × ½ =) ¼ (m^2) for **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(1800 × $\frac{2}{100}$ =) 36 (m^2)	allow (1800 × 0.02 =) 36 (m^2)	1	AO2 4.7.2.1 RPA7
	($\frac{36}{0.25}$ =) 144 (quadrats)	allow (36 × 4 =) 144 (quadrats) allow a correct calculation of number of quadrats with an incorrect calculation of 2% of 1800 allow ecf from question **01.2**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(location of sample will be) biased / chosen **or** (location of sample will be) limited by how far students can throw	allow students may aim for limpets allow students may aim to avoid limpets allow students may stand / start near groups of limpets	1	AO1 4.7.2.1 RPA7
	(therefore) results will not be representative (of (actual) abundance)	allow population size will be too high / low	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	tape measure along two (perpendicular) sides (of sea shore) **or** allocate co-ordinates (to sea shore) **or** divide area into a grid		1	AO1 4.7.2.1 RPA7
	use random number generator	allow description of generating random number(s) for example pulling numbers from container do **not** accept throwing quadrats	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	any **one** from: • water • tide • rocks • quicksand • named hazardous material on the sea shore eg needles, glass • sewage • animals	allow named example of a hazard allow sea allow waves allow slippery / uneven surfaces allow appropriate named animal for example crab / jellyfish	1	AO3 4.7.2.1 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	any **one** from: • fertiliser • sewage • toxic chemicals	allow named toxic chemical eg herbicide / pesticide / insecticide / DDT / (crude) oil allow (micro)plastics allow (dissolved) carbon dioxide allow heavy metals allow thermal pollution	1	AO2 4.7.3.2

Total Question 1	**11**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	domain		1	AO1 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	offspring are genetically identical		1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	a gamete contains half of the number of chromosomes		1	AO1 4.6.1.1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • similar / same structure / characteristics / phenotype (as potatoes)	allow named similar structure / characteristics such as same shape / leaves / flowers / taste allow studied with microscopes ignore 'look the same / similar' unqualified	1	AO1 4.6.4
	• similar DNA / genes	allow DNA analysis allow analysis of genetic material allow similar genetic material ignore genetic information do **not** accept same DNA / genes		
	• similar / same biochemistry			
	• same first part of binomial (name)	allow same first part of Latin / scientific name		

Question	Answers	Mark	AO / Spec. Ref.
02.5	**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 allow reference to named crop throughout **effects of climate change** • climate change will change weather patterns / trends • climate change causes flooding **or** drought **or** temperature change • farming land decreased by sea level rise / flooding / desertification • current crops cannot grow / survive (in changing conditions) **benefits of GM** ○ GM may allow crops to grow in wider range of conditions ○ GM may allow crops to be resistant to wider range of pests / diseases ○ GM may allow crops to be stored for longer ○ GM may increase crop yield **or** increase growth rate ○ to feed the increasing human population ○ useful if less area available for farming ○ larger human population needs more land for housing **other relevant content** ▪ variation amongst current crops reduced by asexual reproduction **or** selective breeding ▪ rate of evolution (by natural selection) may be slower than rate of climate change For **Level 3**, answers must explain effect(s) of climate change **and** benefit(s) of GM with logical link.		4.6.2.4 4.7.3.2 4.7.3.5 4.7.3.6

Total Question 2	**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	parents of child with AKU / disorder do not have AKU / disorder **or** child(ren) with AKU / disorder have parents who do not	allow **A** and **B** do not have AKU, but child / **D** does (have AKU) allow **F** and **G** do not have AKU, but child / children / **K** / **L** does (have AKU) allow child(ren) with AKU / disorder have parents who are carriers	1	AO3 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	G		1	AO2 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(parental gametes) (female) **a and a** (male) **A and a**	allow **1** mark for **a a and A a** parental gametes reversed	1 1	AO2 AO2
	offspring correctly derived **Aa Aa aa aa**	allow correctly derived offspring from incorrect parental gametes	1	AO2
	offspring phenotype correctly derived **Aa** = no AKU **aa** = AKU	allow correctly derived phenotypes from incorrect parental gametes or incorrect offspring genotypes allow inclusion of **AA** = no AKU, if their cross derives this genotype ignore reference to carriers	1	AO2
	(probability =) 0.5	allow 50% **or** ½ **or** 1 in 2 **or** 1:1 **or** 50:50 probability must match offspring genotype do **not** accept 1:2 **or** 50/50	1	AO3 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(mutation causes) incorrect sequence of amino acids		1	AO2 4.6.1.3
	(which) causes the enzyme to be a different shape	allow (which) causes the active site to be a different shape allow which means the enzyme and substrate cannot bind ignore the enzyme is denatured do **not** accept no enzyme produced	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	FSH **and** LH given / injected (into female) to stimulate maturation of egg(s)		1	AO1 4.5.3.3 4.5.3.5
	(collected) egg(s) are fertilised (in laboratory)	allow (collected) egg(s) fused with sperm (in laboratory) allow sperm is injected into egg (in laboratory)	1	
	fertilised egg undergoes mitosis	allow cell(s) undergo mitosis allow fertilised egg divides / develops to form embryo	1	
	(one or two) embryo(s) inserted into uterus / womb **or** (one or two) ball(s) of cells inserted into uterus / womb		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	any **two** from: • risk to embryo	allow risk of miscarriage do **not** accept risk to embryo due to radiation	2	AO3 4.6.1.5
	• risk to female / mother • stressful process • may lead to termination of the pregnancy	allow may lead to destruction of the embryo		
	• (high) cost (of the screening process) • embryo cannot give consent	allow idea of increased prejudice against other people with (inherited) disorders ignore references to religion / ethics		

Total Question 3	**15**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(more) thyroxine secreted / released from thyroid (gland)	allow (more) thyroxine is produced / made / created **alternative answer** (more) adrenaline secreted / released / produced / made / created (1) from adrenal gland (1)	1 1	AO1 4.5.3.6

Question	Answers	Mark	AO / Spec. Ref.
04.2	**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	AO2
	No relevant content	0	
	Indicative content **trends** • percentage of population with resistance increased for 6 months **or** percentage of population with resistance increased when warfarin was given • then decreased after warfarin stopped being given • the decrease is slower than the increase • the change from increase to decrease is not instant (when warfarin stops being given at 6 months) • manipulated figures **increase explanations** • some rats have allele(s) / gene(s) for resistance to warfarin • this is due to (random) mutation(s) • (therefore) more likely to survive if warfarin is being used • rats with resistance reproduce • passing on allele / gene (for resistance) to next generation • repeats for several / many generations until all / most of population is resistant • several generations within 6 months **decrease explanations** • when warfarin is not used, rats with resistance are outcompeted for food / mates / territory / shelter by non-resistant rats • rats with resistance are killed by larger non-resistant rats • (therefore) rats without resistance become more likely to reproduce For **Level 3**, answers must explain increase **and** decrease in percentage of population resistant to warfarin.		4.6.2.2 4.6.3.1 4.6.3.4

Total Question 4	8

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the interaction of (a community of living) organisms and (the non-living parts of) their environment / habitat	allow the interaction of (a community of) biotic parts and the abiotic parts of their environment / habitat allow the interaction of a community and (the non-living parts of) their environment / habitat	1	AO1 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	any **two** from: • may be a predator therefore control prey population • may be prey so provide energy to predator • may be a primary consumer therefore control plant / algae population • may alter habitat for other species (to survive) • may provide shelter for other species (to survive) • may maintain biodiversity • may disperse seed / pollen	allow named examples throughout allow may be predator so keep prey population (fairly) constant ignore may be prey so provide food to predator	2	AO2 4.7.1.1 4.7.2.1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$(\frac{216}{4} =) 54$	allow $(\frac{216\ 000}{4000} =) 54$	1	AO2 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4		ignore references to inversely proportional		
	as number of bacteria increases, the concentration of dissolved oxygen decreases	allow as bacteria increases, oxygen decreases allow there is a negative correlation allow converse	1	AO3 4.7.3.2
	(the relationship is) **not** number of bacteria increases and the concentration of oxygen increases (in the same ratio)	allow (the relationship is) **not** as bacteria increases, oxygen increases allow whereas proportional (relationship) would mean as one increases the other increases (in the same ratio) allow converse	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(decrease in oxygen concentration causes a) decrease in the number of fish	allow (decrease in oxygen concentration means) more fish die	1	AO3
	(because) fish need oxygen to respire (aerobically)	allow invertebrates need oxygen to respire **and** fish eat invertebrates do **not** accept implications that otters require oxygen from water do **not** accept energy produced / made / created by respiration	1	AO2
	(therefore) otter population decreases due to less food	allow rate of reproduction (in otter population) is lower due to less food allow otters migrate to another river / area / habitat ignore decrease in oxygen causes decrease in otter population unqualified **alternative answer** (decrease in oxygen concentration means) more bacteria are present (1) (so) more fish die (from bacterial infection) (1) (therefore) otter population decreases due to less food **or** rate of reproduction (in otter population) is lower due to less food **or** otters migrate to another river / area / habitat (1)	1	AO2 4.7.2.1 4.7.3.2 4.4.2.1

Total Question 5	**9**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	pituitary		1	AO1 4.5.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	increased blood flow to muscles		1	AO1 4.5.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	receptor(s) (cells / neurones)	allow sensory (cells / neurones)	1	AO1 4.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		allow converse if clearly describing people who do not have diabetes		
	blood glucose (concentration) varies more (than in people who do not have diabetes)	allow blood glucose (concentration) increases / decreases more allow blood glucose (concentration) goes very high allow to get a sufficient range of blood glucose (concentrations)	1	AO2 4.5.3.2
	(because) less / no insulin produced when blood glucose (concentration) increases **or** (because) less / no insulin produced to decrease blood glucose (concentration)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **two** from: • prior familiarity with reaction time test • type of (reaction time) test • insulin (injections) • example of named drug (that would affect reaction time) • amount of sleep • distractions	ignore health unqualified allow practice allow description of part of a reaction time test to control eg which hand is used to catch the ruler ignore caffeine / alcohol allow tiredness / sleep	2	AO1 4.5.3.2 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	low / high blood glucose (concentration) is dangerous / unsafe	allow (to monitor for) unconsciousness / coma / headache / dizziness ignore hypoglycaemia / hyperglycaemia unqualified	1	AO3 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	lowest reaction times recorded in (range of) blood glucose (concentration) found in people who do not have diabetes	allow high **and** low blood glucose (concentration) increase (mean) reaction time allow lowest reaction times recorded in range 4.0 to 7.8 ($mmol/dm^3$)	1	AO3
	homeostasis keeps blood glucose (concentration) in a narrow / small range **or** low(er) reaction times are a survival advantage		1	AO2 4.5.1 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.8	when blood glucose (concentration) increases the pancreas releases insulin	allow when blood glucose (concentration) is / nears 7.8 (mmol/dm^3) the pancreas releases insulin allow when blood glucose (concentration) is high the pancreas releases insulin	1	AO1 4.5.1 4.5.3.2
	(insulin causes) glucose to move (from the blood) into the liver / muscle (cells)	if neither mark awarded allow **1** mark for glucose moves into cells	1	
	in (liver / muscle) (excess) glucose is converted to glycogen		1	
	when blood glucose (concentration) decreases the pancreas releases glucagon	allow when blood glucose (concentration) is / nears 4.0 (mmol/dm^3) the pancreas releases glucagon allow when blood glucose (concentration) is low the pancreas releases glucagon	1	
	(glucagon causes) glycogen to be converted into glucose and released into the blood	allow (glucagon causes) glycogen to be converted into glucose which increases blood glucose (concentration)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.9		allow electrical signal for impulse throughout ignore signal / message		
	any **two** from: (if more chemical produced / present) • diffusion of chemical (across synapse) is faster		2	AO2 AO3 4.5.2
	• an impulse in relay / motor / next neurone is more likely	allow an impulse in relay / motor / next neurone is faster / stronger / bigger allow there will be more impulses in relay / motor / next neurone(s)		
	• an impulse is more likely to reach muscle	allow an impulse reaches muscle in less time allow an impulse reaches muscle faster allow bigger impulse causes faster muscle contraction		

Total Question 6	**17**