GCSE
COMBINED SCIENCE: SYNERGY
8465/2H

Higher Tier Paper 2 Life and environmental sciences

Mark scheme

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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.

Further copies of this mark scheme are available from aqa.org.uk

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 his or her judgement
- the Assessment Objectives, level of demand 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.

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**. Different terms in the mark scheme are shown by a / ; e.g. 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 error / 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, 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. Full marks can, however, be given for a correct numerical answer, without any working shown.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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.

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 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.

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, i.e. 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	C		1	4.2.1.6 AO2

Question	Answer	Mark	AO/ Spec. Ref
01.2	**Level 3:** The design / plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1
	Level 2: The design / plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	AO1
	Level 1: The design / plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1
	No relevant content	0	
	Indicative content • consume / eat / drink controlled amounts of caffeine, e.g. volume of cola or fraction of a tablet • include eating / drinking sample with no caffeine (as a control) • control variables considered, e.g. age, no caffeine before the test, time intervals between caffeine, fitness levels • hold metre rule above hand of person to be tested • (so) the 0 mark is level with the top of the hand **or** from same height / position • drop the rule and the other person catches it and record the distance where the rule is caught • convert the distance into time using a standard scale chart **or** calculation • (instead of ruler drop test) use a computer program to determine reaction time or allow description of computer program • repeat the test • calculate a mean • safety issues discussed, e.g. ensuring not too much caffeine is consumed For Level 3 how to change the independent variable **and** a valid method are both described		4.2.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	receptors		1	4.2.1.6 AO1
01.4	any **two** from: • age • medication / drugs / alcohol • level of tiredness • sports specialism (of athletes) • level of training • amount of practise (before test) • distance from the light box • quality of vision	ignore caffeine ignore level of fitness allow height (of person) allow (quality of) background illumination ignore brightness of light box ignore use same light box ignore diet ignore weight / mass / BMI	2	4.2.1.6 AO3
01.5	Test 4		1	4.2.1.6 AO2
01.6	152.62 152.6 (ms)	an answer of 152.6 scores **2** marks allow correct rounding of an incorrect calculated value	1 1	4.2.1.6 AO2
01.7	0.138(2) (s)	allow 0.14 (s)	1	4.2.1.6 AO2
01.8	anomalies can be identified		1	4.2.1.6 AO3
01.9	only tested on one male athlete and one female athlete	allow sample size too small	1	4.2.1.6 AO3
Total			**16**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **two** from: • increased use of electronic devices (for reading / working) • increased recycling of paper • paper production processes are more efficient / modern (and produce less carbon dioxide)	allow less paper used ignore less paper produced ignore references to re-planting trees ignore carbon offset	2	4.4.1.4 AO3
02.2	any **two** from: • decreased use of fossil fuels • increased use of renewable sources for electricity production • increased electricity production from nuclear power stations • increased use of carbon capture / carbon storage • less electricity produced / used (in the UK) • to comply with government regulations	allow named example allow named example allow idea of greater use of energy efficient appliances / devices	2	4.4.1.4 4.4.1.5 AO3
02.3	$\frac{126\ 300\ 000}{631\ 400\ 000} \times 100$ 20 (%)	an answer of 20 scores **2** marks allow $\frac{1263}{6314} \times 100$	1 1	4.4.1.4 4.4.1.5 AO2

Question	Answer	Mark	AO/ Spec. Ref
02.4	**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	AO1
	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 mechanism: • rise in greenhouse gases • carbon dioxide / greenhouse gases absorb (long-wavelength) radiation • (causing) an increase in temperature • (causing) global warming • (causes) climate change consequences of global warming: • melting of ice caps • (causing) sea levels to rise • (causes) flooding (of low-lying land masses) • (causes) habitat destruction • leading to extinction • (causing) reduction in biodiversity • increase in extreme weather • changes in rainfall • (causes) drought / water shortage • (causes) changes to yield of crops in some areas • (may lead to) food shortages • changes to migratory patterns of animals • changes in species distributions • (causes) changes in food webs • increased (geographical) range of tropical diseases • increased absorption of carbon dioxide into the seas and oceans • (causes) acidification of oceans • (which) could lead to changes in species abundance For Level 3 mechanism and linked consequences needed		4.4.1.3 4.4.1.4 4.4.1.5 4.4.2.3 4.4.2.5
Total		**12**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1		in either order allow phonetic spelling		4.2.1.5 AO1
	fatty acids		1	
	glycerol	do **not** accept glucose / glycogen / glucagon	1	
03.2	this is (human) body temperature		1	4.2.1.5 4.3.1.4 AO2
	which is the optimum condition (for enzymes)	allow description ignore bile	1	
03.3	<u>fatty acid(s)</u> are formed		1	4.2.1.5 AO2
03.4	the higher the concentration (of bile), the lower the pH	allow converse allow higher concentration of bile, the less alkaline it becomes	1	4.2.1.5 AO2
03.5		allow converse		4.2.1.5
	(forms) a large surface area for the enzyme / lipase to act upon		1	AO2
	(therefore) lipids are digested a lot faster		1	AO3
Total			**8**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(rose bush) has rose black spot		1	4.2.2.8 AO3
	(because) it has black spots	allow dark / purple spots	1	AO2
	(tomato plant) has tobacco mosaic virus / TMV	allow tomato mosaic virus / ToMV allow cucumber mosaic virus / CMV	1	AO3
	(because) it has a mosaic pattern of discolouration	allow description of mosaic pattern of discolouration	1	AO2
04.2	remove the infected plants / leaves **and** burn / destroy them	ignore clean gardening tools do **not** accept fungicide	1	4.2.2.8 AO2
04.3	(use) fungicide	allow named fungicide allow anti-fungal spray ignore fungal spray	1	4.2.2.8 AO2
04.4	any **five** from: preparation of sample: • make a (thin) section of leaf • place on a microscope slide • add a stain use of microscope: • place slide on stage • switch light on **or** adjust mirror • select the lowest power objective lens • move stage close to lens • turn (coarse) focussing knob until cells in focus • position damaged area in centre of (field of) view • switch to high power (objective) lens • use fine focussing knob to focus	reference to preparation of sample needed for full marks allow named stains ignore place slide on microscope	5	4.1.3.2 AO1

04.5		an answer of 120 scores **3** marks		4.1.3.1
	(plant cell) (60 µm =) 6.0×10^{-5} m **or** (bacterial cell) (5.0×10^{-7} m) = 0.5 µm		1	AO2
	$\frac{6.0 \times 10^{-5}}{5.0 \times 10^{-7}}$ **or** $\frac{60}{0.5}$	allow incorrectly / not converted value for length correctly substituted	1	AO2
	(=) 120	allow a correctly calculated value using an incorrectly / not converted value for length	1	AO2
04.6	a virus is too small to be seen under a light microscope **or** needs an electron microscope to see a virus	ignore a virus is too small to see	1	4.1.3.2 4.1.3.1 AO2
04.7		ignore sulphur		4.2.2.8 4.4.1.6
	the higher the concentration of sulfur dioxide in the air the lower the percentage of rose bushes with infection **or** investigation shows at 100 (µg/m^3) SO_2 there are no rose bushes with infection	allow above 60 (µg/m^3) most rose bushes are not infected allow converse	1	AO3
	(so) before 1956 there was a lot of SO_2 in the air which killed the microorganisms / pathogens / spores / fungi	ignore reference to infection	1	AO3
	(but) after 1956 the levels of SO_2 in the air fell so the microorganisms / pathogens / spores / fungi were able to survive	allow Clean Air Act for 1956 ignore reference to infection	1	AO3
Total			**18**	

Question 5

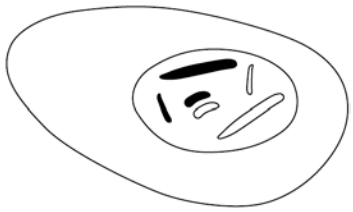
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	mineral / nitrate ion	allow nitrates allow potassium / magnesium / sodium ion do **not** accept nitrogen	1	4.1.3.3 AO3
	(because) it is more concentrated inside the cell	allow converse	1	AO3
	(so) it is moving against / up the concentration gradient **or** (so must) be moving by active transport / uptake	ignore moving along concentration gradient allow from low concentration to high concentration	1	AO2
05.2	cell contents are more concentrated than the 0.2 (mol/dm^3) solution	allow more dilute solution outside the cell allow higher concentration of water outside of the cells	1	4.1.3.3 AO3
	(therefore) water moves into the cells by osmosis	allow water moves into the cells by diffusion do **not** accept active transport	1	AO2
	the cells on the inner edge swell with water	allow cells on the inner edge become turgid allow cells on the inner edge absorb water and expand	1	AO3
	(but) the cells on the outer edge absorb less / no water so the stem curls	allow cells on outer edge absorb water at a slower rate allow cells on outer edge cannot expand and therefore the stem curls	1	AO3
05.3	between 0.2 and 0.4 (mol/dm^3)	allow answer in the range 0.21 to 0.39 (mol/dm^3)	1	4.1.3.3 AO3

05.4	at 0.2 (mol/dm^3) plant cells are absorbing water **and** at 0.4 (mol/dm^3) they are losing water (so) same concentration is when there is no (net) gain or loss of water **or** (so) same concentration is when the stem is the same shape as the original	allow ecf from question **05.3**	1 1	4.1.3.3 AO2

05.5	measure the mass before and after to work out mass gain / loss plot percentage gain / loss on graph and see where the line intercepts 0% change	allow calculate change in mass allow repeat using different concentrations until percentage change in mass is zero	1 1	4.1.3.3 AO3 AO3

Total			**12**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1		should include same number and shape of chromosomes as **Figure 6**, but locations can be different ignore shading	1	4.1.3.4 AO2
06.2	any **four** from: (similarities) • increase in number of organelles / mitochondria / ribosomes (prior to division) • DNA is replicated / doubled • chromosomes are moved to opposite ends of the cell (differences) • cell divides into two genetically identical cells in mitosis but four not genetically identical cells in meiosis • mitosis produces cells with a full set of chromosomes but meiosis produces cells / gametes with half the number of chromosomes	 do **not** accept duplicate / replicate allow chromosomes replicate / double ignore genetic information allow cell increases in volume / size (prior to division) allow cell divides once to produce genetically identical cells in mitosis but cell divides twice to produce not genetically identical cells in meiosis allow mitosis produces diploid cells **and** meiosis produces haploid cells if no other marks awarded allow **1** mark for mitosis produces cells for growth but meiosis produces gametes / sex cells	4	4.1.3.4 4.1.3.5 AO1
06.3	alleles are different forms of the same gene		1	4.4.3.3 AO1

06.4	(allele) that is always expressed **or** only needs one allele to be expressed		1	4.4.3.3 AO1

06.5	(heterozygous) has a child without achondroplasia so must have a recessive allele to pass on **or** because if he was homozygous all of his children would have achondroplasia **or** parent 2 is unaffected, therefore she must have passed on a recessive allele	must give heterozygous to gain reason mark	 1	4.4.3.3 AO3

06.6		if symbols other than A and a used then there must be a key		4.4.3.3
	female A and a **and** male a and a		1	AO2
	(gametes) A a **and** a a		1	AO2
	Aa, Aa, aa, aa	correct derivation from parental gametes	1	AO2
	Aa have achondroplasia **and** aa do **not** have achondroplasia		1	AO3

Total			**12**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	gamma (waves / rays)	allow correct symbol	1	4.1.4.3 AO1
07.2	small device absorbs / receives the radio waves	allow aerial absorbs / receives radio waves	1	4.1.4.4 AO2
	which creates an alternating current of the same frequency (as the radio waves)		1	AO1
07.3	direction of wave is parallel to the wave entering the block and forms a continuous line		1	4.1.4.5 AO2
	wavefronts leaving glass block shown same distance apart as when entering the block		1	
07.4	wave(front) slows down in glass	allow solid for glass allow more dense material	1	4.1.4.5 AO1
	one edge of the wavefront enters the glass before the other		1	
	(therefore) one edge of the wave(front) slows down before the other, so the wave changes direction	allow bends for changes direction if no other mark awarded allow **1** mark for wave(front) changes speed and changes direction when it crosses a boundary	1	

07.5	T = 0.42 s f = 2.38 $0.60 = 2.38 \times \lambda$ $\lambda = \frac{0.60}{2.38}$ λ = 0.25 (m)	an answer of 0.25 (m) scores 5 marks allow a correctly calculated value using an incorrectly / not converted value of T allow use of their value of f calculated using $f = \frac{1}{T}$ for this and subsequent steps allow an answer that rounds to 0.25 (m) consistent with their calculated value of f using $f = \frac{1}{T}$ alternative method T = 0.42 s (1) distance = speed × time (1) allow s = v × t distance is wavelength **and** time is period of the wave (1) λ = 0.60 × 0.42 (1) λ = 0.25 (m) (1)	1 1 1 1 1	4.1.4.2 AO2
Total			**13**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	C		1	4.3.1.5 AO1
08.2	pancreas produces / secretes insulin	do **not** accept liver produces insulin	1	4.3.1.5 AO1
	glucose is taken in to the liver / muscle / cells	do **not** accept taken in to pancreas / pancreatic cells	1	
	(which causes) conversion of glucose to glycogen (in the liver / muscle)	allow phonetic spelling allow glucose is stored as glycogen do **not** accept glucagon	1	
08.3	(if glucagon is blocked) blood glucose concentration is unlikely to rise as high		1	4.3.1.5 AO3
	(so) do not need to inject as much insulin	allow don't need to inject insulin as frequently ignore do **not** need to inject insulin	1	
08.4	any **three** from: • GDM is more likely / prevalent if you have a higher BMI • mothers with GDM are more likely to have heavier (male / female) babies • children born to mothers with GDM are more likely to be overweight when older • boys born to mothers with GDM are more likely to be overweight than girls (when older) • GDM (may have) a greater effect in boys when older than when they are first born	allow converse statements	3	4.3.1.5 AO3
Total			**9**	