GCSE
COMBINED SCIENCE: SYNERGY
8465/1H

Higher Tier Paper 1 Life and Environmental Sciences

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8465/1H/MS

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.

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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	Extra information	Mark	AO / Spec. Ref.
01.1	(ultraviolet radiation) any **one** from: • sunbeds • water purification • fluorescent lamps (infrared radiation) any **one** from: • heaters • cooking • (infrared) cameras	allow any reasonable answer allow sterilising allow killing bacteria allow security marking of banknotes allow detecting blood (in forensics) allow identifying chemicals / pigments / bacteria allow a descriptive use of an infrared camera allow remote control(s)	1 1	AO1 4.1.4.3 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	light is emitted		1	AO2 4.3.2.1 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	3.0×10^8 m/s		1	AO2 4.1.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(wave) speed = frequency × wavelength **or** $v = f\lambda$		1	AO1 4.1.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$300\,000\,000 = 750\,000 \times \lambda$		1	AO2
	$\lambda = \frac{300\,000\,000}{750\,000}$		1	AO2
	$\lambda = 400$		1	AO2
	metres	allow m	1	AO1 4.1.4.2

Total Question 1		**9**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **two** from: • temperature • (no) skin on potato • surface area (of potato pieces) • volume of salt solution • type of potato **or** same potato	ignore mass ignore time allow shape / dimensions (of potato pieces) ignore size / volume (of potato pieces) ignore amount of salt solution	2	AO1 4.1.3.3 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2 view with Table 1	$\frac{(-)0.26 + (-)0.35 + (-)0.32}{3}$ (−)0.31 = −0.31	allow $\frac{(-)0.93}{3}$	1 1 1	AO2 4.1.3.3 RPA4

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2 4.1.3.2 4.1.3.3 RPA 4
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • water enters the cell / potato • by osmosis / diffusion • (water moves in) through (cellulose) cell wall • as it is permeable • (water moves in) through cell membrane • as it is partially permeable • and allows small molecules / water to pass • water moves into cytoplasm • (because) concentration (of salt solution) in cytoplasm is greater than concentration (of salt solution) outside cells • concentration of salt solution in cytoplasm is greater than 0.2 mol/dm^3 • so water moves from an area of higher water concentration to an area of lower water concentration (or expressed as water potential) **or** so water moves from a dilute solution to a more concentrated solution **Level 3** answers refer to explanations linked to cell structure(s)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • high(er) resolution • more detail (in cells) • high(er) magnification	allow 3D image ignore clearer ignore reference to colours	1	AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	1.2 cm = 12 mm $\frac{12}{0.008}$ = (×) 1500	allow 0.008 mm = 0.0008 cm allow $\frac{1.2}{0.0008}$ allow a correct use of incorrect / no conversion of image diameter	1 1 1	AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	starch molecules are insoluble		1	AO1 4.2.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	(starch broken down) to produce glucose by carbohydrase	allow (starch broken down) to produce sugar / maltose allow by amylase ignore enzyme unqualified	1 1	AO1 4.2.1.5

Total Question 2		**18**

Question 3

Question	Answers	Mark	AO / Spec. Ref.
03.1	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.1.1.2 RPA1
	Level 1: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	1–2	
	No relevant content	0	
	Indicative content **method to measure mass** • measure mass on top pan balance • tare / zero top pan balance first **method to measure volume** • fill eureka / displacement can with water • until water overflows and discard water that overflows • place object in • lower in gently (to avoid splashing water) • collect overflow and measure volume displaced • measure volume with measuring cylinder • appropriate volume / size measuring cylinder • read level with water level on measuring cylinder • measure level with bottom of meniscus **or** • part fill a measuring cylinder with water and record volume • appropriate volume / size measuring cylinder • read level with water level on measuring cylinder • measure level with bottom of meniscus • place object in • lower in gently (to avoid splashing water) • record new water level • calculate increase in volume • density = $\frac{\text{mass}}{\text{volume}}$ **Level 2** responses must include sufficient detail to accurately determine density		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$2.70 \times 10^3 = \frac{0.0216}{V}$	allow $2700 = \frac{0.0216}{V}$	1	AO2 4.1.1.2 RPA1
	$V = \frac{0.0216}{2.70 \times 10^3}$	allow $V = \frac{0.0216}{2700}$	1	
	$V = 8.0 \times 10^{-6}$ (m^3)	allow $V = 0.000\ 008$ (m^3)	1	
	cube root = 0.02 (m)	allow 2.0 cm allow use of an incorrectly calculated value of V	1	
	$0.02 \times 0.02 \times 6 = 2.4 \times 10^{-3}$ (m^2)	allow 0.002 4 (m^2) allow 24 cm^2 allow a correct surface area using an incorrectly calculated value of V	1	

Total Question 3		**9**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Eutrema	ignore italics ignore capitals	1	AO2 4.4.4.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	8 (million years ago)		1	AO2 4.4.4.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	*Arabidopsis lyrata* **and** *Arabidopsis thaliana*	in either order allow *A. lyrata* **and** *A. thaliana* ignore italics ignore capitals do **not** accept lyrate rockcress and mouse-ear rockcress allow minor spelling errors	1	AO3 4.4.4.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(mix sample with) ethanol and add (distilled) water	result must correspond with test	1	AO1 4.2.1.5 RPA7
	milky / white / cloudy (if lipid / fat is present)	allow emulsion formed (if lipid / fat is present)	1	
	OR			
	rub food on paper (and allow to dry) (1)			
	greasy mark (if lipid / fat is present) (1)			
		allow apply Sudan Red / III / IV / stain to food (1)		
		red (if lipid / fat is present) (1)		
		OR		
		apply Sudan Black stain to food (1)		
		black (if lipid / fat is present) (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5		allow example of desired characteristic eg white parts like cauliflower		AO1 4.4.4.5 4.4.4.1
	select plants with desired characteristic **and** breed (selected plants) together		1	
	select offspring that have desired characteristic **and** breed (selected offspring) together		1	
	repeat over many generations until all offspring have desired characteristic	do **not** accept idea of repeating with the same parents	1	
		if no other mark awarded allow selective breeding for **1** mark		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	breed one cabbage with one cauliflower (plant)	allow cross pollinate (cabbage and cauliflower)	1	AO1 4.4.4.2
	(if same species) offspring will be fertile	allow description of offspring being able to produce offspring	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	all the genes / DNA in (a nucleus of) an organism	allow all the genetic material in an organism	1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	cauliflower and kale have (6100) more genes in common than cauliflower and cabbage	allow cauliflower and kale have 31 100 genes in common compared to 25 000 for cauliflower and cabbage allow cauliflower and kale have 9000 genes in common, but cauliflower and cabbage **only** have 2900 genes in common ignore 2900 and 9000 unqualified	1	AO3 4.4.4.4 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	$\frac{9000}{2000+2900+22\ 100+9000} \times 100$ = 25 (%)	allow $\frac{9000}{36\ 000} \times 100$	1 1	AO2 4.4.4.4 4.4.3.1

Total Question 4		14

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	two neutrons **and** two protons	allow the nucleus of a helium atom	1	AO1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	1.82×10^{-10} m		1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$\frac{8\ 289\ 864}{198}$ **and** $\frac{7920}{198}$ = 41868 **:** 40 **:** (1)	 allow for **1** mark 40 **:** 41868 **:** (1)	1 1	AO2 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	most / 8 289 864 alpha particles pass straight through (the atom)		1	AO2
	(which) shows that the atom is mostly empty space		1	AO3
	few / 198 alpha particles bounce back	allow few / 198 alpha particles are deflected through a very large angle	1	AO2
	(showing the positive) charge is concentrated (in the centre / nucleus) **or** (showing) most of the mass of the atom is concentrated (in the centre / nucleus)	allow (because) the centre / nucleus has a (positive) charge	1	AO1 4.1.2.1 4.1.2.3 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5		ignore references to atomic number and mass number		AO2 4.1.2.3
	both have 6 neutrons	allow same number of neutrons	1	
	boron has 5 protons and 5 electrons **and** carbon has 6 protons and 6 electrons	allow carbon has 1 more proton **and** 1 more electron (than boron)	1	
	OR			
	boron (atom) has / contains 5 protons, 5 electrons and 6 neutrons (1)			
	carbon (atom) has / contains 6 protons, 6 electrons and 6 neutrons (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	atoms of the same element with different number of neutrons	allow atoms with same number of protons but different number of neutrons	1	AO1 4.1.2.4

Total Question 5		**11**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	bacteria		1	AO1 4.3.3.8 4.4.4.6 4.3.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	any **one** from: • there may be a lack of (human) donors • can plan to have organ available • rejection (by immune system) is less likely	allow have to wait for human donor organ to be available allow organ (from pig) can be changed to be less likely to be rejected	1	AO1 4.3.3.8 4.4.4.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(human) gene is attached / inserted into pig DNA using enzyme(s) transfer into (pig) embryo using a vector / plasmid / virus	allow (human) gene is cut out using enzyme(s) allow (human) gene is attached / inserted into vector / plasmid / virus using enzyme(s) for **2** marks	1 1	AO1 4.3.3.8 4.4.4.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	any **one** from: • more cotton is produced (by each plant) • (farmers of cotton plants) will use fewer / no pesticides • less (insect) damage (to cotton) • make more money / profit	allow (farmers of cotton plants) will not have to buy pesticides	1	AO1 4.3.3.8 4.4.4.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(parental genotypes) **Bb**		1	AO2
	(possible offspring correctly derived) **BB** **Bb** (×2) **bb**	allow correctly derived offspring from incorrect parental genotype(s)	1	AO2
	(each different phenotype identified) **BB and Bb** killed by GM cotton **bb** can eat GM cotton and survive	allow from incorrectly derived offspring	1	AO2
	80 × 0.25 **or** 80 × $\frac{1}{4}$ **or** 80 × $\frac{25}{100}$	if neither mark awarded allow 0.25 / ¼ / 25% / 1 in 4 survive **or** 0.75 / ¾ / 75% / 3 in 4 killed (by eating GM cotton) allow 1 survive : 3 killed for **1** mark do **not** accept 1 in 3 do **not** accept 1:4	1	AO3
	= 20	allow probability / number correctly derived from incorrect parental genotype(s)	1	AO2 4.4.3.3 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	more offspring will be able to eat (GM) cotton and survive (because) only need one copy of dominant allele (to be able to eat cotton and survive) (and so) pass on the dominant allele (therefore) the population (of bollworm) will evolve (to eat GM cotton and survive) faster	allow higher chance for offspring to eat (GM) cotton and survive	1 1 1 1	AO2 4.4.3.3 4.4.3.4 4.4.4.2 4.4.4.6

Total Question 6		**14**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(produces / makes / contains) acid (acid) kills pathogens / bacteria (that are on food)		1 1	AO1 4.3.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	cancer	allow named cancer that can be triggered by HPV allow (genital) warts allow allergy / allergies allow mental illness allow depression	1	AO1 4.3.3.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	antibiotics	allow penicillin or other named antibiotic	1	AO2 4.3.3.6 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	oestrogen progesterone	in either order	1 1	AO1 4.3.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(the STDs are) discontinuous / categoric / discrete (data)	allow (the STDs are) groups of data allow the data is not continuous	1	AO2 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	any **two** from: • lack of information (about actual risk) may make the estimated risk lower than estimated risk of other STDs • more knowledge about an STD may make it appear a greater risk than the actual risk • perception of severity of an STD (compared to others) may make it appear a greater risk than the actual risk	allow more knowledge about an STD may make it appear a greater risk than unknown STDs allow more media / information about an STD may make it appear a greater risk than the actual risk	2	AO3 4.3.3.2 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	(only) barrier methods (reduce the spread of STDs) (because barrier methods) prevent the microorganism / pathogen passing from one person to another	ignore named barrier methods allow description of barrier method(s) allow prevent bacteria / viruses passing from one person to another	1 1	AO1 4.3.3.2 4.3.3.1 4.3.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	immune system is damaged	allow immune system is weakened / attacked	1	AO2
	(so) white blood cells don't function correctly	allow (so there may be) fewer white blood cells	1	AO1
	(therefore) not able to produce antibodies / antitoxins	allow unable to perform phagocytosis	1	AO1
	(therefore) infections that can normally be dealt with by the body have more severe symptoms	allow infections cannot be eliminated / destroyed	1	AO1 4.3.3.2 4.3.3.10 4.3.3.4 4.2.1.4

Total Question 7		**15**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1		allow electrical signal / message for impulse allow spinal cord for CNS		AO1 4.2.1.6
	receptor (in skin) detects touch / pressure / stimulus		1	
	impulse travels from receptor (to CNS) along sensory neurone		1	
	chemicals released across synapse		1	
	impulse travels along relay neurone(s) in CNS		1	
	impulse travels (from CNS to muscle) along motor neurone		1	
	to the effector which creates a response (of the toes curling) **or** to the muscle(s) in toes which contract		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	at first the muscles (have sufficient / enough oxygen to) respire aerobically		1	AO1
	as muscles contract (more frequently) more oxygen is required		1	AO1
	(tight shoe laces) reduces circulation (in feet) so insufficient oxygen (for aerobic respiration) therefore anaerobic respiration occurs		1	AO2
	(accumulation of) lactic acid causes muscle pain / fatigue		1	AO1 4.2.1.1 4.2.1.3

Total Question 8		**10**