GCSE
COMBINED SCIENCE: SYNERGY
8465/1H

Higher Tier Paper 1 Life and Environmental Sciences

Mark scheme

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2 3 6 G 8 4 6 5 / 1 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.

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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	(red blood cells) transport / carry oxygen	ignore reference to haemoglobin	1	AO1 4.2.1.4 4.3.3.4
	(white blood cells) defend against pathogens	allow kill pathogens / bacteria / viruses allow produce antibodies / antitoxins allow phagocytosis ignore reference to diseases / infections	1	
	(platelets) make blood clot	allow clotting allow form scab(s)	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	arrow drawn from left atrium to left ventricle	do **not** accept more than one arrow	1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	D		1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	C		1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	valve(s)	allow named heart valves eg tricuspid / bicuspid / mitral valve	1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	capillaries		1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.7	right atrium		1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.8	carbon monoxide combines / bonds with haemoglobin	ignore carbon monoxide combines / bonds with red blood cells ignore carbon monoxide replaces oxygen in red blood cells	1	AO1
	(so) red blood cells carry less oxygen	allow (so) haemoglobin carries less oxygen allow (so) blood carries less oxygen ignore red blood cells carry no oxygen	1	AO2
	(therefore) blood flow must increase (to meet demand)		1	AO2 4.2.1.3 4.2.1.4 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.9	$\frac{130 - 80}{80} \times 100$	allow $\frac{50}{80} \times 100$	1	AO2 4.4.1.6
	(=) 62.5 (%)	allow 63 (%)	1	

Total Question 1	**14**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	*Lolium*	ignore italics ignore capitalisation do **not** accept *Lolium perenne*	1	AO2 4.4.4.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	chlorophyll(s)		1	AO1 4.2.2.4 4.2.2.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	magnesium ion		1	AO1 4.2.2.2

Question	Answers	Mark	AO/ Spec. Ref.
02.4	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.2.4 RPA9
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • add / mix solvent / ethanol / water with crushed leaves • filter • to remove insoluble parts of leaves • draw start line on (chromatography) paper • use pencil to draw line • place drop of extract / filtrate on pencil / start line • allow to dry • repeat adding drop and drying • place (chromatography) paper in a solvent • solvent level below pencil / start line • allow the solvent to move / run up the paper • mark the position of the solvent front • remove from the solvent and dry • For **Level 3** responses must refer to using pigment from leaves		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	(distance moved by pigment) 5.3 (cm)	allow a value in the range 5.2 to 5.4 (cm)	1	AO2 4.2.2.4 RPA9
	(distance moved by solvent) 8.5 (cm)		1	
	$(R_f =) \frac{5.3}{8.5}$	allow correct use of incorrectly determined distance moved by one of the pigments allow correct use of incorrectly determined distance for solvent	1	
	= 0.62	allow 0.624 / 0.6235 ignore 0.6	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.6	any **one** from: • in dark	allow no light allow lack of light allow no / little water allow no / little carbon dioxide	1	AO2 4.2.2.5
	• (grass) could not photosynthesise			
	• less photosynthesis			
	• the pigment has broken down	ignore less chlorophyll / chloroplasts		

Total Question 2	**14**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	(**A**) evaporation (**B**) condensation	ignore vaporisation	1 1	AO1 4.4.1.7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	any **two** from: • (adding) chlorine • (adding) ozone • (exposing to) UV / ultraviolet light	allow boiling / distillation	2	AO1 4.4.1.8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	(sea water) distillation is used **or** (sea water) reverse osmosis is used **or** (for sea water) desalination is required (which) requires (more) energy	allow converse if clearly referring to river water	1 1	AO1 4.4.1.8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	any **two** from: • fertiliser • herbicide • pesticide	allow named fertiliser allow weedkiller allow insecticide / fungicide	2	AO2 4.4.1.8 4.4.2.6 4.4.4.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	(sewage sludge) anaerobic digestion (effluent) aerobic biological / bacterial (treatment)	 allow aerobic digestion if no other mark awarded allow **1** mark for (sewage sludge) anaerobic **and** (effluent) aerobic	1 1	AO1 4.4.1.8

Total Question 3	**10**

Question 4

Question	Answers	Mark	AO/ Spec. Ref.
04.1	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.1.3.1 RPA3
	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 • place slide on stage • angle mirror to reflect light up through slide / cells • adjust to lower power objective lens over slide • look through eyepiece • move slide so cells are visible • focus (under lower power objective lens) using coarse focus adjustment • moving stage up / down to focus • move to high power objective lens • gradually move the objective lens away / up (from the stage) (may describe stage moving away from lens or down) • using fine focus adjustment For **Level 2** the response should describe how to focus using coarse then fine adjustment		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	electron microscopes can have a magnification of × 1 000 000 electron microscopes have a high resolving power		1 1	AO1 4.1.3.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	a mutation for resistance occurs	allow variation exists in plant population	1	AO2
	plants (with the mutation) more likely to survive and breed		1	AO1
	passing on allele(s) / gene(s) / chromosome(s for resistance)	allow passing on the mutation ignore passing on the characteristic	1	AO1
	repeats over many generations	allow description	1	AO1 4.4.4.2

Total Question 4	**10**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	kill / trap pathogens / bacteria / microbes / microorganisms	allow trap particles / dust ignore viruses ignore stops pathogens / bacteria / microbes / microorganisms entering ear	1	AO3 4.3.3.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	(small) section of DNA that codes for a specific protein	 allow codes for a sequence of amino acids	1 1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	two parents with dry earwax do not have offspring with wet earwax (so dry must be recessive) **or** if wet earwax is recessive, if both parents have wet earwax all offspring would have wet earwax	allow two parents with dry earwax only have offspring with dry earwax (so dry must be recessive)	1	AO3 4.4.3.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	(parental genotypes) (wet) **Ee** **and** (dry) **ee**		1	AO2
	(offspring genotypes correctly derived) **Ee Ee ee ee**	allow **Ee ee** allow from incorrect parental genotypes	1	AO2
	Ee = wet **and** **ee** = dry		1	AO2
	(theoretical ratio) 1:1	allow probability of each phenotype 0.5 / 50% / 1 in 2 do **not** accept 1 in 1	1	AO3
	205:195 is close to 1:1	allow difference in ratio is due to chance **or** random fertilisation	1	AO3 4.4.3.3

Total Question 5	**9**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1		allow converse if clearly referring to carbon-12		AO2 4.1.2.4
	(carbon-14 has) two more neutrons	allow carbon-14 has 8 neutrons **and** carbon-12 has 6 neutrons ignore references to same number of protons and same number of electrons	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2		allow producers / algae for plants reference to carbon-14 is only required once		AO2 4.2.2.2 4.2.2.3 4.4.2.1 4.2.2.5 4.2.1.5 4.4.1.2
	carbon dioxide enters (plant) through leaves / stomata	ignore guard cells	1	
	plants / producers / algae photosynthesise using carbon dioxide (that contains carbon-14)	allow plants take in carbon-14 when they photosynthesise	1	
	carbon-14 then in glucose / sugar / starch	allow carbon-14 then in cellulose / fat / oil / lipid / amino acids / protein	1	
	plants / glucose / sugar eaten by animals		1	
	molecules containing carbon-14 absorbed (into animal tissues)	allow glucose / amino acids / fatty acids / glycerol containing carbon-14 are absorbed	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	$^{0}_{-1}(e) + {}^{14}_{7}(N)$	top row numbers correct	1	AO1
		bottom row numbers correct	1	AO2
		if MP1 and MP2 not awarded allow **1** mark for $^{0}_{-1}(e)$		
	symbol matching atomic number		1	AO2 4.3.2.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	(decay requires) decomposers / bacteria / microorganisms / microbes / fungi	ignore (decay requires) worms / insects / detritivores	1	AO2 4.4.1.2 4.2.1.1
	(but) in a glacier there is not enough oxygen for (aerobic) respiration	allow (but) in a glacier there is no oxygen for (aerobic) respiration allow (but) in a glacier it is too cold for enzyme activity	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.5	> 5400 years		1	AO2 4.3.2.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.6		allow activity for number of nuclei allow count rate for number of nuclei		
	after 30 years the number of nuclei (of the isotope) in the sample will halve		1	AO1
	in the next 30 years the number of nuclei (of the isotope) remaining will halve again		1	AO2
	(so) after 60 years 25% / ¼ of the original sample will remain **or** (so) half of the sample that was there after 30 years will remain after 60 years	allow an example using numbers to illustrate halving twice in 60 years	1	AO2 4.3.2.3

Total Question 6	**15**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	ΔE = 1 260 000(J)		1	AO2 4.1.1.4
	1 260 000(J) = 5.0 × 4200 × temperature change	allow a correct substitution using an incorrectly / not converted value of ΔE	1	
	temperature change = $\frac{1\ 260\ 000}{5.0 \times 4200}$	allow temperature change = $\frac{1\ 260\ 000}{21\ 000}$ allow a correct rearrangement using an incorrectly / not converted value of ΔE	1	
	temperature change = 60 °C	allow correct calculations using an incorrectly / not converted value of ΔE	1	
	starting temperature = 15 °C		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2		allow converse if clearly referring to water-filled heater		
	(oil has) lower specific heat capacity	allow clear comparison of numbers	1	AO2
	(therefore oil) requires less energy to cause the same temperature change	allow (oil) requires less energy to raise the temperature by 1 °C	1	AO3 4.1.1.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	(average) kinetic energy of the (gas) molecules increases **or** (gas) molecules move faster	allow particles / atoms for molecules throughout	1	AO1
	molecules collide with the wall of container		1	AO1
	these collisions are more frequent so pressure increases **or** each collision exerts more force so pressure increases	allow these collisions occur at a greater rate so pressure increases MP3 dependent on MP2	1	AO2 4.1.1.3

Total Question 7	**10**

Question 8

Question	Answers	Mark	AO/ Spec. Ref.
08	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO1 4.2.2.3 4.2.2.7
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content similarities • both specialised for transport of materials • both tissues contain cells with similar structure / function • both contain elongated cells • both form long tubes • both found in veins • both found in stems / leaves / roots of plants differences • xylem is dead and phloem is living • xylem transports water and minerals / ions whereas phloem transports sugars / sucrose • xylem involved with transpiration and phloem involved with translocation • xylem transports (water) from roots to leaves whereas phloem transports (sugars) from leaves to rest of plant • xylem transport is in one direction whereas phloem is in both directions • xylem is hollow (and phloem is not) • xylem is strengthened by lignin (and phloem is not) • xylem cells do not have end walls (and phloem cells do) • end walls of phloem cells have pores (and xylem cells do not have pores) • phloem transport requires active transport (and xylem transport does not) • companion cells are part of the phloem tissue (and xylem cells do not have companion cells) indicative content may be shown on annotated diagram(s) For **Level 2** responses must refer to similarities and differences		

Total Question 8	**6**

Question 9

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.1	any **two** from: • concentration of acid • type of acid • temperature	ignore time allow the acid used allow (initial) pH of acid ignore reference to volume / amount of acid ignore reference to alkali / indicator ignore density of the gel / cube(s)	2	AO3 4.1.3.3 4.2.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.2	(4^3 =) 64 (cm^3)		1	AO2 4.1.3.3 4.2.1.2
	(64 – 27 =) 37 (cm^3)	allow correct subtraction from incorrectly calculated volume of cube	1	
	$\frac{37}{64}$ × 100	allow correct percentage calculation from incorrect volume changed colour	1	
	58 (%)	allow an answer of 57.8125 correctly rounded to any decimal place	1	
	alternative route (4^3 =) 64 (cm^3)			
	$\frac{27}{64}$ × 100	allow 42.1875 correctly rounded to any decimal place allow 42		
	100 – 42	allow correct subtraction from incorrectly calculated percentage		
	58 (%)	allow an answer of 57.8125 correctly rounded to any decimal place		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.3		allow reference to food molecules or gas(es) or named examples		
	(very) small organisms rely on diffusion through their outer surface for exchange of materials		1	AO1
	(but) as organisms get larger, surface area to volume ratio decreases		1	AO1
	(which) limits the volume (of material) that can be received / removed	allow which means they may not receive / remove enough (material)	1	AO2
	(so) exchange surfaces / adaptations are needed	allow named example of exchange surface needed allow have transport system is needed	1	AO1 4.1.3.3 4.2.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.4	any **two** from: • organisms are not cube shaped	 allow cubes and organisms have different shapes	2	AO3 4.1.3.3 4.2.1.2
	• organisms have specialised exchange organs / surfaces	allow (some) organisms have lungs / gills / villi / alveoli / capillaries / leaves / roots allow (some) organisms have transport / circulatory systems		
	• organisms are not the same material all the way through	allow organisms are composed of different tissues / organs		
	• organisms are not made of gel	allow gel (cube) is not a living organism		

Total Question 9	**12**