GCSE
COMBINED SCIENCE: SYNERGY
8465/1H

Higher Tier Paper 1 Life and Environmental Sciences

Mark scheme

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2 4 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.

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	Extra information	Mark	AO / Spec. Ref.
01.1	prokaryotic		1	AO1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **one** from: (bacterial cells) • have a cell wall • have single loop of DNA • (may) have plasmid(s) • do not have mitochondria	allow converse if clearly referring to animal cells ignore ribosomes, vacuole, flagella ignore size	1	AO1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	any **one** from: • boil(ing) • chlorine / iodine tablets • using UV light • using ozone		1	AO1 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	78 **and** 8 $\frac{78}{8}$ 9.7(5)	allow readings in the range of 77 to 79 and 7 to 9 allow use of their incorrect readings allow 9.8 allow 10 allow correct calculation using their incorrect readings	1 1 1	AO2 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **one** from: • (each) increase in cases occurs (about) 5 days after an increase in rainfall • the pattern of cases follows the pattern of rainfall but 5 days later	allow highest rainfall is on day 12 and the highest infections on day 17, (which is 5 days later)	1	AO3 4.4.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	climate change is causing more extreme rainfall		1	AO2 4.4.1.8 4.4.1.5 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	water vapour methane	ignore water allow nitrous oxide allow ozone	1 1	AO1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	any **one** from: • burn less fossil fuel • use renewable sources of energy (in place of fossil fuels) • plant more trees • capture and store carbon dioxide	allow burn less coal / oil / gas allow use electric cars allow less deforestation	1	AO1 4.4.1.5

Total Question 1	**11**

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.2.6
	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 **Independent variable** • independent variable is the light intensity • measure distance between lamp and pondweed • increase the distance to decrease the light intensity • use at least 5 light intensities **Dependent variable** • dependent variable is rate of photosynthesis or number of bubbles or volume of gas • count number of bubbles in set time • collect gas for set time and measure volume • repeats and calculate a mean **Control variables** • method of controlling temperature (e.g. use LED bulb or heat shield or beaker for pondweed tube) • method of controlling (dissolved) carbon dioxide concentration • method of controlling other light sources in room • allow pondweed to adjust to new light intensity before taking readings • size of pondweed • species of pondweed For **Level 3,** answers must give detail of independent variable, dependent variable and control variable		

Total Question 2	**6**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	perpendicular		1	AO1 4.1.4.1

Question	Answers	Mark	AO / Spec. Ref.
03.2	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3-4	AO1 4.1.4.1
	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: **method to measure time** • measure a time • measure a suitable time e.g. 10 seconds • use suitable equipment e.g. stopclock, mobile phone, timestamp on video **method to count waves** • count the number of waves • count the number of waves passing the mark on the tank • use a camera / phone to record video • replay video using slow motion **calculation of frequency** • frequency is the number of waves passing the mark on the tank each second • divide the number of waves passing the point by the time elapsed an alternative method using a strobe can gain full credit an alternative method measuring wavelength and wave speed to determine frequency can gain full credit		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	$v = f \lambda$		1	AO1 4.1.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	λ = 1.6 cm or λ = 16 mm	allow 1.5 cm to 1.7 cm or 15 mm to 17 mm	1	AO2 4.1.4.2
	λ = 0.016 (m)	allow a correct conversion of their value into metres	1	
	v = 2.5 × 0.016	allow a correct substitution using an incorrectly / not converted value of λ allow a correct substitution using their value of λ	1	
	v = 0.040 (m/s)	allow an answer in the range 0.0375 (m/s) to 0.0425 (m/s) allow a correct calculation using an incorrectly / not converted value of λ that is within the range for MP1	1	

Total Question 3	**10**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	measles is (caused by) a virus	allow it is a virus allow antibiotics do not kill viruses allow measles / it is not (caused by) a bacteria ignore references to protists / antimalarials	1	AO2 4.3.3.6 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	mucus (in nose / trachea / bronchi / airways) catches / traps pathogen cilia move mucus (containing the pathogen) to be removed / swallowed	allow virus / bacteria / microorganisms / microbes for pathogen throughout	1 1	AO1 4.3.3.1 4.3.3.2 4.3.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	to cause the blood to clot		1	AO1 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(white blood cells) produce antibodies to measles (pathogen)	allow (white blood cells) produce specific antibodies ignore memory cells	1	AO1 4.3.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	6 **:** 1		1	AO2 4.3.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6		allow converse if clearly referring to a low ratio of vaccinated to unvaccinated		
	(high ratio of vaccinated : unvaccinated means) most of population are immune		1	AO2 4.3.3.5
	(so) low chance of spread / transmission of measles / pathogen		1	
		if no other mark awarded allow for **1** mark high vaccination ratio will give herd immunity		

Total Question 4	**8**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		allow converse if clearly referring to conscious actions		AO1 4.2.1.6
	automatic	ignore not conscious allow do not think about reflex / action / response / movement allow impulse does not have to travel to the brain first	1	
	and			
	quicker	answer must be comparative allow faster allow more rapid allow happens in less time		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	receptors (in skin) detect the stimulus / object / pain / pressure		1	AO1 4.2.1.6
	(starting an) impulse along the sensory neurone		1	
	to relay neurones in the CNS / spinal cord	if neither MP2, MP3 nor MP4 is awarded allow **1** mark for sensory neurone, relay neurone and motor neurone in this order	1	
	(causing an) impulse along motor neurone		1	
	signal to muscle to contract (to move foot away / up)		1	
	chemical crosses synapse between neurone(s)	allow description between any two neurones	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **one** from: • experience of the reaction time test • experience of the SRT / CRT task • using the same SRT and CRT tests (for all students) • caffeine intake • no distractions	allow other drugs allow size of each group allow tiredness ignore temperature ignore named aspect of health ignore height / weight	1	AO1 4.3.1.1 4.2.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	910 **and** 740 (ms / milliseconds)	allow 900 to 920	1	AO2 4.2.1.6
	(910 – 740 =) 170 (ms / milliseconds)	allow a correct answer using incorrect values from the graph	1	
	0.170 (seconds)	allow 0.17 (seconds) allow a correct conversion of an incorrectly determined time allow a correct conversion from milliseconds to seconds at any stage	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(evidence to support the statement:) decreasing reaction time with (increasing) age for simple **and** choice reaction time		1	AO3 4.2.1.6
	(evidence which does **not** support the statement:) results / mean for all age ranges, for both SRT and CRT, are not secure due to the wide range of results	allow results / mean for all age ranges, for both SRT and CRT, are not statistically significant due to the wide range of results allow the maximum and minimum ranges overlap therefore the statement may not be true for all students	1	

Total Question 5	**13**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	volcanic activity	allow volcanoes	1	AO1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	corresponding values for *x*-step **and** *y*-step from tangent		1	AO2 4.4.1.1
	(rate =) $\frac{\text{value for } y\text{- step}}{\text{value for } x\text{- step}}$	allow correct use of an incorrectly determined value from tangent for *x*-step and/or *y*-step	1	
	correct calculation of rate (% per billion years)		1	
	correct calculation of rate given to 2 significant figures (% per billion years)	allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses data derived from the tangent	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	carbon dioxide (from atmosphere) dissolved in the ocean(s)	allow carbon dioxide produced carbonates in sediment allow carbon dioxide was used up in the formation of sedimentary rocks allow carbon dioxide was used up in the formation of limestone allow carbon dioxide was used up in the formation of fossil fuels	1	AO1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	algae photosynthesised		1	AO1
	(which) produced oxygen		1	AO2
	(and) produced glucose		1	AO2
	(therefore) animals had a source of energy through respiration **or** (therefore) animals could produce amino acids	do **not** accept energy was produced / made / created allow (therefore) animals could produce protein(s) if no other mark awarded allow **1** mark for algae are producers (for animals to consume)	1	AO2 4.4.1.1 4.2.2.5 4.2.1.1

Total Question 6	**10**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	living and non-living parts of an environment	allow living and non-living parts of an area / place / habitat	1	AO1 4.4.2.1

Question	Answers	Extra informationn	Mark	AO / Spec. Ref.
07.2	population is number of one species whereas community is all the populations (of all the species in the habitat)		1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(seal population could decrease) because polar bears will eat more seals		1	AO2 4.4.2.1 4.4.2.2 4.4.2.3
	(seal population could increase) because there will be more fish available to eat		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(producers to primary consumers) $\left(\frac{68 \times 8.4}{100} = \right) 5.712$	allow (68 × 0.084 =)5.712	1	AO2 4.4.2.1
	(primary consumers to secondary consumers) $\left(\frac{5.712 \times 8.4}{100} = \right) 0.479808$	allow (5.4 × 0.084 =)0.479808	1	
	(secondary to tertiary) $\left(\frac{0.45696 \times 8.4}{100} = \right) 0.040(30\ldots)$	allow (0.479808 × 0.084=) 0.040(30…) allow **3** marks for $68 \times 0.084 \times 0.084 \times 0.084 = 0.040(30\ldots)$ **or** $68 \times 0.084^3 = 0.040(30\ldots)$ allow **2** marks for $68 \times 0.084 \times 0.084 = 0.047(98\ldots)$ **or** $68 \times \left(\frac{8.4}{100}\right) \times \left(\frac{8.4}{100}\right) \times \left(\frac{8.4}{100}\right)$ allow **1** mark for 0.084^3	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	active transport		1	AO1 4.1.3.3 4.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	magnesium (ions) needed to make chlorophyll	allow a lack of magnesium (ions) causes a lack of chlorophyll ignore nitrate ions are needed to make chlorophyll	1	AO1
	lack of chlorophyll reduces rate of photosynthesis		1	AO2
	(therefore) less glucose produced	allow lack of molecules synthesised from glucose	1	AO2
	nitrate (ions) needed to make proteins	allow nitrate (ions) needed to make amino acids	1	AO1
	(then) lack of protein decreases rate of growth	allow lack of protein causes lack of enzymes	1	AO2 4.2.2.2 4.2.2.5 4.2.1.5

Total Question 7	**13**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	mitosis		1	AO1 4.1.3.4 4.2.2.1
	differentiation	ignore specialisation ignore growth	1	

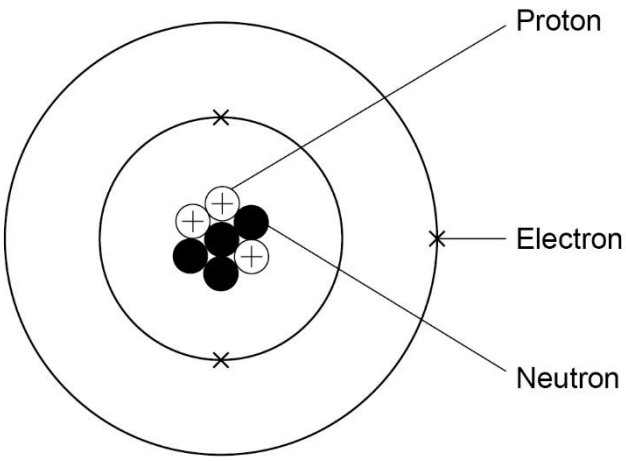
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	seed produced by fertilisation of gametes	allow seed produced by fusion of gametes allow seeds produced from egg and pollen	1	AO2 4.1.3.5 4.1.3.4
	each seed will be genetically different		1	
	the gall (cells) are produced by mitosis which produces genetically identical cells		1	
		if no other marks awarded allow **1** mark for fertilisation involves two cells joining to form one cell, but mitosis involves one cell dividing to form two cells		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	xylem		1	AO1 4.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	the mutation / lignin made (insect) embryo less likely to be eaten	allow the mutation / lignin made (insect) embryo more likely to survive	1	AO2
	(therefore insects) can reproduce and pass on mutation		1	AO1
	(which is) repeated over many generations (until all population had mutation)		1	AO1 4.4.4.2

Total Question 8	**9**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	3 electrons in 2,1 arrangement	allow any combination of dots, circles, crosses, $e^{(-)}$ for electrons	1	AO2 4.1.2.3 4.1.2.4
	3 protons labelled in nucleus		1	4.1.2.5
	4 neutrons labelled in nucleus		1	
	an answer of  scores **3** marks			

Question	Answers	Mark	AO / Spec. Ref.
09.2	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO1 4.1.2.1
	Level 1: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1–2	
	No relevant content	0	
	Indicative content <u>Dalton atom</u> • spherical atoms • that cannot be split up <u>plum pudding model</u> • electrons were discovered • it was found that the mass of electrons was very much less than the mass of atoms • so electrons must be sub-atomic particles • so the atom is a ball of positive charge with negative electrons embedded in it <u>nuclear atom</u> • an experiment showed that most of the alpha particles directed at thin gold foil passed through but a few bounced back • suggesting the mass of an atom was concentrated at the centre • suggesting that the nucleus was positively charged		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(conversion) (0.348 nm =) 0.348×10^{-9} (m)	allow 0.000 000 000 348 (m)	1	AO2 4.1.2.2
	$= 3.48 \times 10^{-10}$ (m)	allow an answer correctly given in standard form from an incorrect calculation of the radius in metres	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(if pure, the change of state) will be at a specific temperature	allow if not pure, (the change of state) will not be at a specific temperature allow melting point or boiling point for change of state	1	AO1 4.1.1.5

Total Question 9	**10**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	E = 33 000 (J)		1	AO2 4.1.1.4
	33 000 = 0.15 × L	allow a correct substitution using an incorrectly / not converted value of E	1	
	$L = \frac{33\,000}{0.15}$	allow a correct rearrangement using an incorrectly / not converted value of E	1	
	L = 220 000 (J/kg)	allow an answer consistent with an incorrectly / not converted value of E	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	the energy measured is greater than the energy needed to melt the wax		1	AO3 4.1.1.4
	and this (greater energy) value is divided by the same value for mass, so the calculated specific latent heat is too high	allow joulemeter reading for energy	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	$\Delta\theta = 82 - 70$	allow $\Delta\theta = 12$	1	AO2 4.1.1.4
	$4950 = 0.15 \times c \times 12$	allow a substitution using an incorrectly calculated value of $\Delta\theta$	1	
	$c = \frac{4950}{0.15 \times 12}$	allow a correct rearrangement using an incorrect value of temperature for $\Delta\theta$	1	
	$c = 2750$ (J/kg°C)	allow an answer consistent with an incorrect value of $\Delta\theta$ allow an answer of 2800 (J/kg°C)	1	

Total Question 10	**10**