

Higher

GCSE

Combined Science Physics A Gateway Science

J250/12: Paper 12 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate). *When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response)**

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks)**

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
 - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
9. *Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.*

10. For answers marked by levels of response: Not applicable in F501

- a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
- b. **To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.















In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper is **15(c)**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science A:

	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	B ✓	1	1.1	
2	A ✓	1	1.1	
3	B ✓	1	1.1	
4	D ✓	1	2.1	
5	A ✓	1	2.1	
6	C ✓	1	2.1	
7	D ✓	1	2.1	
8	C ✓	1	2.1	
9	C ✓	1	2.2	
10	A ✓	1	2.1	

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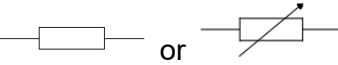
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Question			Answer	Marks	AO element	Guidance
11	(a)	(i)	<p>(Mistake – measure volume / use a balance) Correction – measure <u>mass</u> / find <u>mass</u> / calculate <u>mass</u> ✓</p> <p>Mistake – (only) measure starting temperature / (only) measure one temperature ✓</p> <p>Correction – measure final temperature / measure temperature change / calculate temperature change ✓</p>	3	3 × 1.2	<p>ALLOW mistakes in any order ALLOW corrections written on the mistake lines</p> <p>Note this mark is for the correction (no mark for the mistake) IGNORE use a measuring cylinder</p> <p>IGNORE add a lid</p>
		(ii)	<p>Any one from:</p> <p>Take repeat readings (and average) ✓</p> <p>Add a lid / cover the top ✓</p> <p>Stir the water ✓</p> <p>Include the specific heat capacity of the saucepan in the calculation ✓</p> <p>Use a digital thermometer ✓</p>	1	3.3b	<p>IGNORE in a closed system / same size saucepan</p>

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11	(b)	<p>Any three from:</p> <p>Correct symbol for resistor (heater) ✓</p> <p>Voltmeter to measure pd or voltmeter in parallel with heater ✓</p> <p>Ammeter to measure current or ammeter in series with heater ✓</p> <p>(Stopwatch) to measure time / use a set amount of time e.g. 10 minutes ✓</p> <p>Any one from:</p> <p>Power = potential difference x current ✓</p> <p>Energy = power x time ✓</p> <p>Charge = current x time ✓</p> <p>Energy = charge x potential difference ✓</p> <p>Power = (current)² x resistance ✓</p>	4	3 × 3.3a 1.2	<p>ALLOW variable resistor symbol, so symbols</p> <p></p> <p>ALLOW voltmeter to measure voltage IGNORE voltmeter to measure volts</p> <p>IGNORE ammeter to measure amps</p> <p>ALLOW (stopwatch) to measure a unit of time e.g., minutes or seconds</p> <p>ALLOW voltage or pd for potential difference</p> <p>ALLOW voltage or pd for potential difference</p> <p>ALLOW energy = potential difference x current x time ALLOW symbol equation</p>
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Question		Answer	Marks	AO element	Guidance
12	(a)	<p>The nucleus contains protons and neutrons ✓</p> <p>The nucleus has a positive charge ✓</p>	2	2 × 1.1	<p>Each correct tick = 1 mark</p> <p>Three ticks with two correct = 1 mark</p> <p>Three ticks with one correct = 0 marks</p> <p>More than three ticks = 0 marks</p>
	(b)	<p>As time increases, mass decreases / ORA ✓</p> <p>(Mass decreases) at a decreasing rate / decreasing gradient ✓</p>	2	2 × 3.1a	<p>ALLOW inversely related / inversely proportional</p> <p>IGNORE negative correlation</p> <p>ALLOW at the beginning the mass decreases and then it slows down</p> <p>ALLOW marking points combined e.g. mass decreases at a decreasing rate / as time goes on the less the mass decreases / as time continues it loses mass more slowly = 2 marks</p> <p>IGNORE references to half-life or activity</p>

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Question		Answer	Marks	AO element	Guidance
13	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.028 (m) award 4 marks</p> <p>(Wavelength =) wave speed / frequency ✓</p> <p>(Wavelength =) $3 \times 10^8 \div 1.07 \times 10^{10}$ ✓</p> <p>(Wavelength =) 0.0280007 (m) ✓</p> <p>(Wavelength =) 0.028 (m) to 3 decimal places ✓</p>	4		<p>IGNORE wave speed = frequency x wavelength (in question)</p> <p>1.2 ALLOW symbol equation / equation in any form</p> <p>2.1</p> <p>2.1 IGNORE 0.03</p> <p>1.2 ECF for any correct 3 decimal places but must be a visible change from one figure to another e.g. 4.23416 changed to 4.234 = 1 mark</p>
	(b)	Cannot see radio or IR / eyes detect only a limited range of frequencies / AW ✓	1	2.1	ALLOW so it can be seen / so it is visible / to show it is working / to check it is working
	(c) (i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.12 (kWh) award 4 marks</p> <p>Power saved = 15 (W) or 15/1000 (kW) or 0.015 (kW) ✓</p> <p>(Energy =) power × time ✓</p> <p>(Energy =) 0.015×8 ✓</p> <p>(Energy =) 0.12 (kWh) ✓</p>	4		<p>1.2</p> <p>1.2 ALLOW symbol equation / equation in any form</p> <p>2.1</p> <p>2.1 ECF for no or incorrect conversion of 15 W, so any power of ten difference e.g. 120 = 3 marks (no conversion 15×8) 12 = 3 marks (incorrect conversion 1.5×8)</p> <p>ECF for incorrect power saved e.g. when power saved is taken as 10(W) rather than 15(W)</p> <p>ECF for time converted into minutes or seconds</p>

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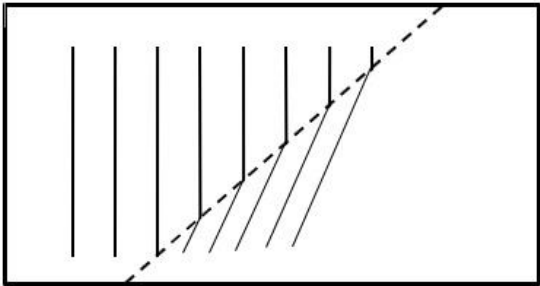
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Question			Answer	Marks	AO element	Guidance
13	(c)	(ii)	<p>Any two from:</p> <p>To find how much energy appliance(s) uses ✓</p> <p>To find energy use at different times / to find energy use per day ✓</p> <p>To find cost (of energy) ✓</p> <p>To (try to) decrease usage of energy (at home) ✓</p> <p>(May help) conserve (non-renewable) energy resources ✓</p> <p>No need for person to come to home to read the meter (so saving fuel in car) ✓</p> <p>Idea that it will not help because some people ignore the smart meters ✓</p>	2	2 × 1.2	<p>ALLOW electricity or power for energy</p> <p>ALLOW electricity or power for energy</p> <p>ALLOW idea of budgeting</p> <p>ALLOW to save energy</p> <p>ALLOW named examples of (non-renewable) energy resources</p>

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Question		Answer	Marks	AO element	Guidance
14	(a)	Place (sheet of) plastic in tray or in ripple tank or in water / decrease depth of water ✓ (Water) waves change speed / travel slower / ORA ✓	2	2 × 2.2	ALLOW under the water DO NOT ALLOW idea that the plastic floats IGNORE light refracts / light reflects / water reflects IGNORE waves travel faster in shallow water IGNORE the water waves go through the (sheet of) plastic
	(b)	For one mark: Wave pattern shown bending ✓ OR Wave pattern lines are closer together ✓ For two marks: Wave pattern shown bending in correct direction (towards the normal) AND wavefronts are continuous with incident wavefronts AND wave pattern lines are closer together ✓✓ 	2	2 × 2.1	

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Question		Answer	Marks	AO element	Guidance
15	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8.51×10^{16} (Bq) award 2 marks</p> <p>Activity = $2\,300\,000 \times 37\,000\,000\,000$ (Bq) ✓</p> <p>Activity = 8.51×10^{16} (Bq) ✓</p>	2	<p>1.2</p> <p>1.2</p>	<p>ALLOW 85 100 000 000 000 000</p> <p>ALLOW 8.5×10^{16} (Bq) or 9×10^{16} (Bq)</p> <p>ALLOW 8.51×10^n for 1 mark for any other power of 10</p> <p>ECF for calculated value changed into correct standard form e.g. 0.0000621 changed to 6.21×10^{-5} = 1 mark</p>
	(b)	$\begin{array}{c} 137 \\ \dots \\ 55 \end{array} \text{Cs} \rightarrow \begin{array}{c} 137 \\ \dots \\ 56 \end{array} \text{Ba} + \begin{array}{c} 0 \\ \dots \\ -1 \end{array} \beta$ <p>Cs correct mass and atomic number (137, 55) ✓</p> <p>Ba correct mass and atomic number (137, 56) ✓</p> <p>β correct mass and atomic number (0, -1) ✓</p>	3	3 × 1.1	<p>ALLOW 1 mark maximum for atomic masses or atomic numbers that balance if no other mark scored</p>

Question		Answer	Marks	AO element	Guidance
15	*(c)	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks)</p> <p>Understanding of half-life by use of calculations AND analyses information about contamination including a calculation based on safety limits</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks)</p> <p>Understanding of half-life by use of a calculation AND analyses information about contamination</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks)</p> <p>Basic understanding of half-life OR basic description of contamination</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	2 x 1.2 2 x 3.1b 2 x 3.2a	<p>AO1.2 – Demonstrates knowledge and understanding of half-life</p> <ul style="list-style-type: none"> Half-life is the time taken for (the number of undecayed) nuclei to halve / activity to halve I-131 is 8 days / Cs-137 is 30 years <p>AO3.1b – Analyses information and ideas to evaluate the information from the graphs</p> <ul style="list-style-type: none"> Fraction of Cs-137 remaining after 26 years is 0.54 or 0.55 or 0.56 Cs-137 activity will now read approximately $0.55 \times 1600 = 880$ Bq <p>AO3.2a – Analyses information and ideas by making judgements from graphs</p> <ul style="list-style-type: none"> Sheep are contaminated as the radioactive substance has touched the sheep / been ingested Beta and/or gamma radiation is ionising and may cause cancer After 26 years no or very little I-131 left / I-131 poses no threat Activity of Cs-137 is higher in environment for a much longer time After 26 years, sheep are under the safety limit

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Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	B or C or D ✓	1	3.2b	ALLOW one or more of the possible correct answers
		(ii)	B ✓	1	3.2b	
	(b)		<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.48 (J) award 3 marks</p> <p>(Kinetic energy =) $0.5 \times \text{mass} \times \text{speed}^2 / \frac{1}{2}mv^2$ ✓</p> <p>(Kinetic energy =) $0.5 \times 0.06 \times 4^2$ ✓</p> <p>(Kinetic energy =) 0.48 (J) ✓</p>	3	1.2 2.1 2.1	<p>ALLOW symbol equation / equation in any form</p> <p>ECF for incorrect mass conversion, so any power of ten difference e.g. 4.8 (J) = 2 marks 0.048 (J) = 2 marks but not when time used instead of speed e.g. 0.4 is the time so $(0.4)^2 \times 0.5 \times 0.06$ is not correct</p>
	(c)	(i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.75 (J) award 4 marks</p> <p>Area under graph of ABC = height or = $0.5 \times 5 \times 0.5$ ✓</p> <p>(Height =) 1.25 (m) ✓</p> <p>(Potential energy =) $0.06 \times 10 \times 1.25$ ✓</p> <p>(Potential energy =) 0.75 (J) ✓</p>	4	1.2 2.1 2.1 2.1	<p>ALLOW ecf from incorrect height calculated e.g. height 2.5 gives 1.5 (J) = 2 marks</p> <p>ALLOW 4 marks for 0.735 or 0.74 if 9.8 used for gravitational field strength</p> <p>DO NOT ALLOW height = 0 (m) so 0 marks for question</p>

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		(ii) FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.6 award 3 marks	3		ALLOW ecf from (c)(i) e.g. 0 in part (c)(i) gives answer of infinity
		(Efficiency =) $\frac{\text{useful output energy transfer}}{\text{input energy transfer}}$ ✓		1.2	ALLOW $\frac{\text{output}}{\text{input}}$
		(Efficiency =) $\frac{0.45}{0.75}$ ✓		2.1	
		(Efficiency =) 0.6 (no units) ✓		2.1	DO NOT ALLOW unit e.g. 0.6 J = 2 marks ALLOW answer with percentage sign e.g. 60% = 3 marks 0.6% = 2 marks

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