OCR
Oxford Cambridge and RSA

Higher

GCSE

Combined Science Physics A Gateway Science

J250/12: Paper 12 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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.

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 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 available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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 50% 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, email or via the RM Assessor messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed-out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed-out answer and award marks appropriately.

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 the annotation SEEN to confirm that the work has been read.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

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 email.

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:

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 questions on this paper is **16**.

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	C	1	1.1	
2	A	1	1.2	
3	A	1	1.2	
4	A	1	2.1	
5	C	1	1.1	
6	D	1	2.1	
7	B	1	2.1	
8	B	1	1.1	
9	C	1	2.1	
10	B	1	2.1	

Question			Answer	Marks	AO element	Guidance
11	(a)		They have been irradiated only ✓	1	2.1	**ALLOW** any indication of the first box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked
	(b)		They have been irradiated and contaminated ✓	1	2.1	**ALLOW** any indication of the third box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked
	(c)		They have **not** been irradiated or contaminated ✓	1	2.1	**ALLOW** any indication of the fourth box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked

Question			Answer	Marks	AO element	Guidance
12	(a)		Gamma rays ✓	1	2.2	**ALLOW** gamma / symbol γ
	(b)		Gamma rays ✓	1	1.1	**ALLOW** gamma / symbol γ
	(c)		10^2 ✓	1	2.2	**ALLOW** any indication of the correct answer selected e.g., ticking or underlining but circling takes precedence **DO NOT ALLOW** more than one answer circled
	(d)		**First check the answer on answer line** **If answer = 1 000 000 (Hz) award 2 marks** (Frequency =) 10^6 (Hz) ✓ (Frequency =) 1 000 000 (Hz) ✓	2	 1.2 2.2	**ALLOW** answer on graph **ALLOW** 1 x 10^6 (Hz) for 1 mark **ALLOW ECF** from standard form to non-standard form e.g., 10^7 to 10 000 000 (Hz) for 1 mark
	(e)		They are transverse waves ✓	1	1.1	**ALLOW** any indication of the fourth box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked

	(f)		**First check the answer on answer line** **If answer = 0.7 (h) award 3 marks** (Time =) $\frac{\text{energy transferred}}{\text{power}}$ ✓ (Time =) $\frac{0.56}{0.8}$ ✓ (Time =) 0.7 (h) ✓	**3**	**1.2** **2 × 2.1**	**ALLOW** POT error e.g., 7 / 70 / 0.07 on answer line = 2 marks **ALLOW** symbols (t =) $\frac{W}{P}$ or $\frac{E}{P}$ **ALLOW** for 1 mark the numbers in an unrearranged equation e.g.: 0.56 = 0.8 x t

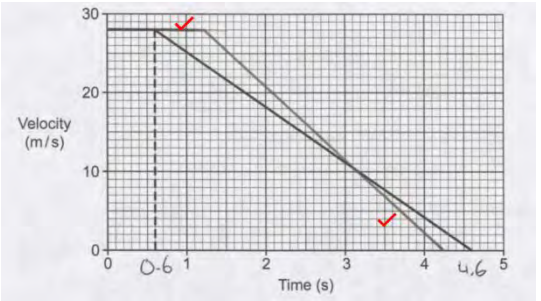
Question			Answer	Marks	AO element	Guidance
13	(a)		**Any two from:** (Demand) increases at/from 14:00 ✓ (Demand) peaks during range 17:00 to 20:00 ✓ (Demand) dips (slightly) during the peak / increases and then decreases (during the peak) ✓ (Demand) decreases at/from 19:00 to 20:00 ✓ (Demand) decreasing at 23:00 / less at 23:00 than 14:00 ✓	2	2 × 3.1a	**ALLOW** times using non 24-hour clock e.g., 2(pm) and 11(pm) **IGNORE** reasons and explanations for changes **ALLOW** peak at any time in this range e.g., peaks at 18:00 / up until 18:00 / to 18:00 **ALLOW** decrease at/from any time in this range e.g., decreases at 19:30 **ALLOW** demand at 14:00 is high and demand at 23:00 is low Alternative method using MW: increases at/from 27 500 or 27 800 (MW) peaks during range 32 000 to 33 000 (MW) dips (slightly) during the peak / increases and then decreases decreases at/from 32 500 to 33 000 (MW) decreasing at 23:00 / less at 23:00 than 14:00 / at 23:00 is 22 000 to 23 000 (MW) **ALLOW** mixture of time and MW but must be **different** marking points

	(b)		**Any two from:** Gas fired power stations are quick to start up ✓ (Rapid) increase in demand / extra energy/power needs to be generated ✓ (Because) people are waking up / people need to make breakfast / people are using (electrical) devices ✓	**2**	**2 × 3.2a**	 **ALLOW** needs to be a power station that is quicker (to start) **ALLOW** make sure enough power is available / to meet the demand / know demand is going to increase **IGNORE** references to incorrect times and just **ALLOW** for the action that increases the demand e.g., people use showers / cook food / switch TV on for 1 mark

	(c)	(i)	**First check the answer on answer line** **If answer = 62.5 (%) award 3 marks** (Peak =) 32 800 **OR** (Baseload =) 20 500 ✓ $\frac{20\,500}{32\,800}$ × 100 ✓ 62.5 (%) ✓	**3**	**2.2** **2 × 1.2**	**ALLOW** (peak =) in the range 32 700 to 32 900 (baseload =) in the range 20 400 to 20 600 **ALLOW** answer in the inclusive range 0.62 to 0.63 for 2 marks **ALLOW** answer in the inclusive range 62 to 63 for 3 marks **ALLOW ECF** for correct substitution e.g.: baseload 20250 peak 32800 (1 mark) $\frac{20\,250}{32\,800}$ × 100 (1 mark)
		(ii)	Fossil fuel / nuclear ✓	**1**	**1.1**	**ALLOW** gas / diesel / coal / oil **IGNORE** electric **DO NOT ALLOW** any renewable resources

Question			Answer	Marks	AO element	Guidance
14	(a)		**First check the answer on answer line** **If answer = 33 000 (V) award 2 marks** 4500 × 132 000 = 18 000 × p.d. **OR** (p.d. =) $\frac{4500 \times 132\,000}{18\,000}$ ✓ (p.d. =) 33 000 (V) ✓	**2**	**2 × 2.1**	
	(b)		**Any one from:** 98% of the energy output is useful ✓ 98% of the energy input is usefully transferred ✓ 2% of the energy output is wasted or dissipated ✓	**1**	**1.1**	**ALLOW** power for energy throughout question **ALLOW** 98% of the energy is used **IGNORE** only works 98% of the time **ALLOW** 2% of energy (output) is 'lost' (to the surroundings) / 98% of energy is not 'lost' (to the surroundings)

Question			Answer	Marks	AO element	Guidance
15	(a)	(i)	2.48 (m/s^2)	1	2.2	**ALLOW** answer in the inclusive range 2.46 to 2.5(0)
		(ii)	**First check the answer on answer line** **If answer = 3.0 (m/s^2) award 2 marks** Attempt at extrapolation of graph ✓ 3.0 (m/s^2) ✓	2	2 × 2.2	**IGNORE** equation of motion use **ALLOW** any line from 800 back towards the y-axis **ALLOW** 3 (m/s^2) **ALLOW** answer in the inclusive range 2.9 to 3.1 for 2 marks
	(b)		Travelling along a motorway ✓	1	2.1	**ALLOW** any indication of the second box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked

	(c)	(i)	**Any one from:** Velocity/speed of driver unchanged/constant ✓ Decelerates/brakes after/at 0.6 s ✓	**1**	**3.2b**	**ALLOW** graph/line is flat/horizontal **IGNORE** graph/line is straight **ALLOW** velocity reduces after/at 0.6 s **DO NOT ALLOW** thinking distance is 0.6 s / decelerates for 0.6 s / brakes for 0.6 s
		(ii)	**First check the answer on answer line** **If answer = 56 (m) award 2 marks** Attempt to calculate area under graph / ½ × 4 × 28 ✓ (distance =) 56 (m) ✓	**2**	**2 × 1.2**	**ALLOW** ½ × 4.6 × 28 or 64.4 for 1 mark
		(iii)	Horizontal line at 28 m/s continuing for a time greater than 0.6 s ✓ Diagonal line drawn steeper than original line ✓	**2**	**2 × 1.2**	Mark independently **ALLOW** curved diagonal line drawn overall steeper than original looking for: 

Question			Answer	Marks	AO element	Guidance
16	*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation of half-life supported with an accurate representation on the graph **AND** Detailed description of an experiment to measure half-life *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Clear explanation of half-life with half-life represented on the graph **OR** Clear explanation of half-life with a clear description of an experiment to measure half-life *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Basic explanation of half-life or basic representation on the graph **OR** Basic description of an experiment to measure half-life *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant***.**	**6**	**2 × 1.1** **2 × 1.2** **2 × 2.2**	**AO1.1 - Demonstrates knowledge and understanding of half-life and how it is represented on a graph** • time taken for activity (of isotope) to halve • time taken for mass (of isotope) to halve • time taken for number of (undecayed) nuclei to halve • time taken for a fixed proportion of the nuclei to decay is constant • half-life is constant **ALLOW** time taken to halve at Level 1 only **DO NOT ALLOW** time for a nuclei / an atom / a nucleus to halve **AO1.2 / 2.2 – Demonstrates and applies knowledge and understanding of scientific techniques to measure half-life** • measure the activity with no isotope present / measure background radiation • measure number of counts • measure number of counts in a fixed time / measure the time it takes for activity to halve • use a Geiger(-muller) tube / use a Geiger counter / use a becquerel counter • use a radiation detector at a fixed distance from the isotope • repeat the measurements for a period of time • draw on the graph to show how the half-life can be represented by the time taken for the activity to halve

			0 marks *No response or no response worthy of credit.*			

Question			Answer	Marks	AO element	Guidance
17	(a)		**Any two from:** Particles vibrating parallel to the direction of propagation/travel of the wave ✓ Longitudinal ✓ Compressions **and** rarefactions ✓ Compressions are high pressure areas/particles are close together ✓ Rarefactions are low pressure areas/particles are far apart ✓ Description of a wavelength ✓ Travel faster in solid/liquid than air ✓	**2**	**2 × 1.1**	**ALLOW** marking points on a labelled diagram **ALLOW** 'slinky' type diagram **IGNORE** drawing of a transverse wave (wavy line) **ALLOW** air/particles move back and forth / air/particles oscillate **ALLOW** compressions and rarefactions parallel to direction of wave for 2 marks
	(b)	(i)	**First check the answer on answer line** **If answer = 336 (m / s) award 3 marks** (Wave speed =) frequency × wavelength ✓ (Wave speed =) 4 × 0.175 × 480 **or** 0.7 × 480 ✓ (Wave speed =) 336 (m/s) ✓	**3**	 **1.2** **2.1** **2.1**	 **ALLOW** 0.175 x 480 for 1 mark **ALLOW** 84 for 2 marks

Question			Answer	Marks	AO element	Guidance
		(ii)	**First check the answer on answer line** **If answer = 2.5 (%) award 3 marks** (Range =) 16 (m / s) ✓ (Mean =) 320 (m / s) ✓ (% uncertainty =) 2.5 (%) ✓	**3**	**3 × 3.3b**	**ALLOW** an error in the calculation for 2 marks e.g., any of the following as the final answer: 0.5 / 0.025 / 25 / 1.09(375) or 1.1 / 0.78(125)
		(iii)	Precision:	**2**	**2 × 3.1b**	

			(Yes because) results are close together / range is small **Or** (No because) results are not close together / range is large ✓ Accuracy: (No because) too far from the true value **Or** (Yes because) near to true value ✓			**ALLOW** use of data e.g., (Yes as) range is only 16 / (no as) range is 16 / too far from 343 / lower than 343 / no value near 343 / not around the 340 / closest answer is 13 / mean is only 23 away / (yes as) no outliers / (yes as) no anomalies **ALLOW** use of data e.g., (mean) is only 23 from true value / close to 343 / within 10% of true value / student's answer is only 7 away **ALLOW** use of the following data to explain answers to precision and accuracy: **Student** / **Speed of sound (m/s)** 1 / 314 2 / 320 3 / 330 4 / 315 5 / 321 Range = 16 m/s Mean = 320 m/s Speed of sound = 343 m/s Student's answer = 336 m/s

		(iv)	Holding the tuning fork as close as possible to the end of the tube ✓	**1**	**3.3a**	**ALLOW** any indication of the first box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked
		(v)	Using a ruler with a zero error ✓	**1**	**3.3b**	**ALLOW** any indication of the fourth box selected e.g., X or circling but ticking takes precedence **DO NOT ALLOW** more than one box ticked

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