OCR
Oxford Cambridge and RSA

Higher

GCSE

Combined Science B Twenty First Century Science

J260/07: Physics (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2024

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 a tick to confirm that the work has been seen.

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 question on this paper is **1**

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

11. 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

12. **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 B:

	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.

Question			Answer	Marks	AO element	Guidance
1*			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)** Describes in detail the risks **AND** benefits of using solar and wind instead of fossil fuels **AND** explains how pumped storage can be used to match supply to demand and reduce risks. *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)** Describes in some detail risks **OR** benefits of using solar and wind instead of fossil fuels **AND** explains how pumped storage can be used to match supply to demand and reduce these risks. **OR** Describes in some detail a risk **AND** benefits of using solar an winds instead of fossil fuels *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)** Describes a risk **OR** a benefit of using solar and wind instead of fossil fuels **OR** Explains how pumped storage can be used to match supply to demand. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	**4 x 1.1** **2 x 2.1**	**AO1.1 - Demonstrates knowledge and understanding of benefits and risks of use of wind farms and solar panels:** **Benefits:** Reduces global warming Not burning fossil fuels so carbon dioxide not produced Solar and wind are renewable so do not run out Wind turbines/solar panels do not produce carbon dioxide / greenhouse gases No air pollution (at point of use) **Risks:** Not reliable / do not produce electricity when conditions not right Solar not available at night Wind does not always blow Not a steady supply Difficult to match supply to demand More solar available in summer but more heat/lights required in winter **AO2.1 – Applies knowledge and understanding to explain how pumped storage systems can help to reduce risks** When excess electricity is generated it can be used to pump water to the upper reservoir Energy is stored and can be used to generate electricity and provide a constant supply / not weather dependent

Question			Answer	Marks	AO element	Guidance
						Pumped storage used to match supply to demand more effectively

Question			Answer	Marks	AO element	Guidance
2	**(a)**		Measure the distance travelled along the ramp / length of the ramp (with a ruler). ✓ Measure the time for the trolley to travel down the ramp (with a stopwatch) ✓	**2**	**1.2**	
	(b)	**(i)**	The graph is a curve / not a straight line ✓ The gradient of the graph gives the speed. ✓ The gradient increases with time. ✓	**2**	**3.1a**	**ALLOW** curve gets steeper **ALLOW** greater distance in same time later
		(ii)	**First check the answer on answer line** **If answer = 16 ± 2 (cm/s) award 4 marks** Tangent drawn at 5 s ✓ Use of data from graph, e.g. (8.0, 92) and (2.4, 0) ✓ Use of triangle method, e.g. (92 – 0) / (8.0 – 2.4) ✓ = 16 ± 2 (m/s) ✓	**4**	**2.2**	**ALLOW** line touching curve (OR misses by < 1mm) AND which does not cross curve. Check read-offs should be accurate to within a small square **ECF** for last 3 marks for incorrect straight line drawn
	(c)	**(i)**	**First check the answer on answer line** **If answer = 0.896 (N) and 0.904 award 4 marks** Selection of equation: force = mass x acceleration ✓ Use of data from graph: When falling weight = 0.5 N, a = 1.12 m/s^2 ✓ Substitution: F = 0.80 x 1.12 ✓ = 0.896 N ✓	**4**	**1.2** **2.2 x 3**	**ALLOW** acceleration between 1.12 and 1.13 m/s^2 inclusive **ECF** final two marks for incorrect acceleration from graph **ALLOW** answer between 0.896 and 0.904 N inclusive **ALLOW** correct answer rounded to fewer SF **ALLOW** maximum of 3 marks for POT error
		(ii)	The acceleration caused by the slope of the ramp ✓	**1**	**3.1a**	

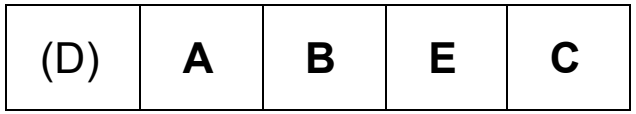
Question			Answer	Marks	AO element	Guidance

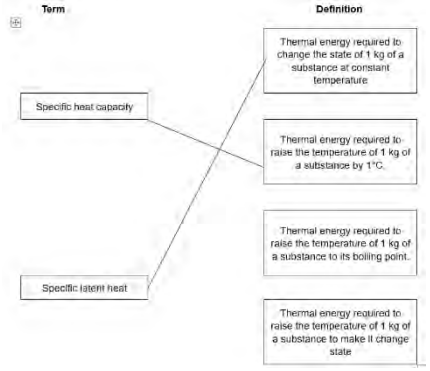
Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	Light waves are electromagnetic waves ✓ Light waves are transverse waves ✓	2	1.1	Boxes 1 and 3 ticked. **ALLOW** any unambiguous indication. Mark independently. If 3 or more ticks treat each additional tick as a contradiction of one correct tick.
		(ii)	Wavelengths ✓ Reflected **AND** absorbed ✓	2	1.1	In this order only
	(b)	(i)	Waves on the rope are transverse and sound waves are longitudinal ✓ In transverse waves vibrations / oscillations are perpendicular to the direction of the wave / energy transfer ✓ In longitudinal waves vibrations / oscillations are parallel to the direction of the wave / energy transfer ✓	3	1.1	
		(ii)	Amplitude = 0.10 (m) ✓ Wavelength = 1.5 (m) ✓	2	2.2	**IGNORE** negative
		(iii)	Frequency = 2 (Hz) ✓ Period = 0.5 (s) ✓	2	1.2	

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	(G) **E** **A** **B** **D** **F** (C) ✓✓	2	1.2	All correct = 2 marks Any two or three out of the following = 1 mark E before A A before B B before D D before F
		(ii)	**Any two from:** Draw curtains/blinds/do experiment at night ✓ Turn off light sources in the room ✓ Use brighter bulb/laser ✓	2	3.3b	**ALLOW** other sensible ways to reduce sunlight e.g. screens, set up in large box **ALLOW** other sensible suggestion to make brighter e.g. increase current/voltage/power of bulb **ALLOW** 1 mark for use a dark room if no other mark scored
	(b)	(i)	Angle of reflection = **A** ✓ Angle of refraction = **D** ✓	2	1.2	
		(ii)	Angle of refraction = 32 (°) ✓	1	1.2	**ECF** from part **(b)(i):** If angle of refraction = **A ALLOW** 50.5 / 51(°) If angle of refraction = **B ALLOW** 39 / 39.5(°) If angle of refraction = **C ALLOW** 58(°)
	(c)		**First check the answer on answer line** **If answer = 4.3 x 10^{-7} award 3 marks** Substitution: (wavelength) = 2 × 10^{8} / 4.7 × 10^{14} ✓ = 4.2553… x 10^{-7} (m) ✓ = 4.3 × 10^{-7} (m) (2sf) ✓	3	**2.1 x 2** **1.2**	**ALLOW** an incorrect calculated answer correctly given to 2sf **DO NOT ALLOW** final mark for 4.255 x 10^{-7} (m) incorrectly rounded to 4.2 × 10^{-7} (m) Power of ten error scores 2 marks maximum.
	(d)		Decreases ✓ The frequency must remain constant (as the light wave passes from air to glass) ✓ (Since v = f λ, λ must decrease) when v decreases. ✓	3	1.1	Marking points are all independent.

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	**Any two from:** Work done by electric current (flowing in the motor) ✓ Work done on the load (by the force produced by the motor / by the tension in the string) ✓ gravitational potential energy (of load) increases ✓	2	1.1	**ALLOW** electrical work/transfer **ALLOW** mechanical work/transfer **ALLOW** kinetic store of <u>motor</u> **AND** <u>load</u> increases
		(ii)	energy from the source is transferred as thermal energy OR energy transferred to thermal energy (store) of the environment / motor / moving parts ✓ **AND** **Any one from:** By the electric current (flowing in the motor) ✓ By frictional forces ✓	2	1.1	**ALLOW** heat for thermal **IGNORE** sound Must refer to where energy originated or where it is going. **ALLOW** Kinetic energy in the motor is transferred as thermal energy
	(b)	(i)	**First check the answer on answer line** **If answer = 10.8 (J) award 3 marks** Algebraic substitution of P = IV into E = Pt: E = IVt ✓ Numerical substitution: E = 2.0 x 3.0 x 1.8 ✓ **OR** Calculation of power: P = 2.0 x 3.0 = 6.0 (W) ✓ Substitution into E = Pt: E = 6.0 x 1.8 ✓ = 10.8 (J) ✓	3	2.1	**ALLOW** 11(J)
		(ii)	**First check the answer on answer line** **If answer = 0.75 or 75<u>%</u> award 2 marks** Substitution: Efficiency = 8.1 / 10.8 ✓ = 0.75 ✓	2	2.1	**ALLOW ECF** answer to **b(i)** for 10.8 **ALLOW** 75 <u>%</u> **DO NOT ALLOW** 0.75%
	(c)		**Any three from:**	3	3.1b	

Question			Answer	Marks	AO element	Guidance
			speed x mass (= constant) ✓ Uses (at least) two pairs of corresponding values of mass and speed from the graph (e.g (0.1, 0.80) and (0.2, 0.50) ✓ Calculates speed x mass correctly for at least one pair ✓ conclusion given that is consistent with the data (e.g calculated values not constant so student conclusion is wrong) ✓			

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	C ✓	1	2.1	
		(ii)	A ✓	1	2.1	
	(b)	(i)	 ✓✓	2	1.2	All correct = 2 marks Any two correct = 1 mark A before B B before E E before C
		(ii)	**Any two from:** As the distance increases the calculated speed increases / approaches the actual speed of sound ✓ As the distance increases the calculated speed becomes more accurate ORA ✓ (because) the measurement of time becomes more accurate ✓ **AND:** Idea that Hiro's reaction time becomes less significant / the random errors in the times become less significant / percentage error in time decreases as distance increases. ✓	3	3.2b	**ALLOW** percentage uncertainty for percentage error

Question			Answer	Marks	AO element	Guidance
7	(a)		 ✓ ✓	2	1.1	
	(b)	(i)	**First check the answer on answer line** **If answer = 0.04 (g/cm^3) award 4 marks** Selection of data from graph: Volume at B = 20.8 cm^3 ✓ Substitution: Density at B (=20/20.8) ✓ = 0.96 g/cm^3 ✓ Change in density = (1 – 0.96) = 0.04 (g/cm^3) ✓	4	2.1	**ECF** for final 3 marks if volume read incorrectly from graph **IGNORE** negative **ALLOW** 0.0384615 rounded correctly to any number of SF
		(ii)	The same number of molecules/particles ✓ Move apart / take up more space ✓	2	1.1	**ALLOW** amount for number
		(iii)	Density decreases (suddenly at 100°C) ✓ **AND any two from:** As the liquid changes to a gas ✓ Volume / space between particles increases ✓ Mass is unchanged ✓	3	3.2a	**IGNORE** water boils / reaches boiling point **IGNORE** mass is conserved

Question			Answer	Marks	AO element	Guidance
8	(a)		As resistance is increased the current is decreased ✓ And so potential difference across component X is decreased ✓ **OR** As resistance is increased the potential difference across variable resistor is increased ✓ And so the potential difference across component X is decreased ✓	**2**	**1.2**	**ALLOW** consistent reverse argument for both marking points. **ALLOW** explanation that pd across components is in ratio of their resistances. **ALLOW** consistent reverse argument for both marking points. Note that stand alone statement that potential difference across X decreases/increases does not score.
	(b)	(i)	I = 0 between p.d. of 0 and 0.5 V ✓ Graph starts to slope upwards between p.d. of 0.5 V and 1.0 V ✓	**2**	**1.2**	The transition between the two parts of the graph can be curved or sharp.
		(ii)	**X** is a diode / LED ✓	**1**	**1.2**	
	(c)		**First check the answer on answer line** **If answer = 3.84 (C) award 3 marks** Conversion: 12.8 mA = 0.0128 A ✓ Substitution: Q = 12.8 ($\times 10^{-3}$) x 300 ✓ = 3.84 (C) ✓	**3**	**1.2** **2.1 x 2**	**ALLOW** 2 marks for 3.84 to any other power of ten

Question			Answer	Marks	AO element	Guidance
9	(a)		The (magnetic) field is (vertically) upwards / North to South ✓ The current is from + to – **OR** from B to A ✓	2	2.2	**ALLOW** diagram e.g. x ,y and z directions represented by arrows in correct orientation AND correctly labelled **ALLOW** current out of page
	(b)		**Any two from:** Increase magnetic field strength ✓ Increase current (in copper wire) ✓ Increase length of copper wire (inside the magnetic field) / increase separation of rails✓	2	2.1	**ALLOW** stronger magnets **IGNORE** bigger / more magnets **IGNORE** reference to coils
	(c)	(i)	**First check the answer on answer line** **If answer = 0.04 (m) award 3 marks** Rearrangement: l = F/BI ✓ Substitution: l = (0.0060 / 0.1 × 1.5) ✓ = 0.04 (m) ✓	3	2.1	Substitution and rearrangement can be in either order **ALLOW** substitution into an incorrect algebraic rearrangement for this mark only.
		(ii)	**First check the answer on answer line** **If answer = 30 (m/s^2) award 4 marks** Conversion: 0.20 g = 0.0002 kg ✓ Rearrangement: a = F / m ✓ Substitution: a = 0.0060 / 0.2 (×10^{-3}) ✓ = 30 (m/s^2) ✓	4	1.2 2.1 x 3	Substitution and rearrangement can be in either order **ALLOW** substitution into an incorrect algebraic rearrangement for this mark only. **ALLOW** 3 marks for 30 to any other power of ten
		(iii)	**First check the answer on answer line** **If answer = 1.2 (m/s) award 3 marks** Selection of equation: $v^2 - u^2 = 2as$ ✓ Substitution: v^2 (– 0) = 2 × 36 × 0.02 **OR** v^2 = 1.44 ✓ v = 1.2 (m/s) ✓	3	1.2 2.1 x 2	**ALLOW** answer of 1.44 for 2 marks

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