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 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 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 **2**

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.

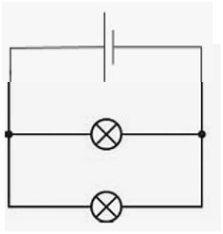
The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science B:

	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	(a)		All electromagnetic radiation travels through space at the same speed. ✓ Our eyes can only detect a limited range of electromagnetic frequencies. ✓	2	1.1	Ticks in 2nd and 4th boxes **ALLOW** any unambiguous indication Mark independently. If 3 or more ticks treat each additional tick as a contradiction of one correct tick.
	(b)	(i)	From left to right: Radio, Microwave, (Infrared), Visible, Ultraviolet, X rays, Gamma rays Radio before Microwave Microwave before Infrared Infrared before Visible Visible before Ultraviolet Ultraviolet before X-ray X-ray before gamma ✓✓✓	3	1.1	Before means anywhere to the left All 6 correct = 3 marks 4 or 5 correct = 2 marks 2 or 3 correct = 1 mark
		(ii)	increases ✓ increases ✓	2	1.1	
	(c)	(i)	**Any one from:** Develop new theories ✓ Evidence for theories (e.g. big bang) ✓ Improve understanding ✓ Increase knowledge ✓ Generate interest in cosmology/astronomy ✓ (Astronomers can) take measurements from them ✓	1	2.1	**DO NOT ALLOW** reference to planets, the Sun, the Earth, asteroids, meteors, comets, aliens or life on other planets, the idea we might travel there. **ALLOW** refs to stars for galaxies. **IGNORE** reference to imaging galaxies
		(ii)	**Any one from:** Informed decisions can be made about risks / benefits / costs / ethical issues ✓ Generate interest in cosmology/astronomy ✓ Discoveries can be peer reviewed/checked ✓ Idea of wider / (global) collaboration ✓	1	2.1	**IGNORE** making people aware / sharing discoveries

Question			Answer	Marks	AO element	Guidance
2	(a)		**Renewable:** Solar / hydroelectric / tidal / biofuel / wave / geothermal ✓ **Non-renewable:** fossil fuels / coal / oil / (natural) gas ✓	2	1.1	**IGNORE** wind **IGNORE** Nuclear **ALLOW** petrol / diesel / named hydrocarbon
	(b)*		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)** A description of how nuclear fuel and wind are used to generate electricity **AND** Analysis of the chart to include a comparison, which maybe use of nuclear fuel in 2016 with use in 2020 **OR**, use of wind in 2016 with use in 2020 **OR** use of wind with use of nuclear fuel in a particular year **OR** comparison of rate of change. *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)** A partial description of how electricity is generated from wind or nuclear fuel **AND** A partial analysis of the chart. For example, a statement about how the use of nuclear fuel and wind has changed, or a simple comparison of how the use of one has changed between two years.	6	4 x 1.1 2 x 3.1a	**AO1.1 Demonstrate knowledge and understanding of scientific ideas.** How nuclear fuel is used as an energy resource to generate electricity: • Uranium (-235) fuel • Nuclear fission releases energy • Steam turns turbines • Turbines turn generators • Extra detail: e.g. reference to control rods / coolant / moderator / detail on fission process / detail on the generator How wind is used as an energy resource to generate electricity: • Use of (wind) turbines • Wind turns blades of wind turbines • Turbines turn generators • Extra detail: e.g. detail on the generator

Question			Answer	Marks	AO element	Guidance
			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)** A partial description of how electricity is generated from wind or nuclear fuel **OR** A partial analysis of the chart. For example, a statement about how the use of nuclear fuel and wind has changed, or a simple comparison of how the use of one has changed between two years. *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.*			**AO3.1a Analyse information and ideas to interpret.** How use of nuclear fuel has changed 2016-20: • Decreased • Ref. to data e.g. From ~180 000 GWh to ~125 000 GWh (allow ± 5000 GWh) How use of wind has changed 2016-20: • Increased • Ref. to data e.g. From ~50 000 GWh to ~90 000 GWh (allow ± 5000 GWh) How relative use of fuel has changed • More energy from nuclear fuel used than from wind. • Was much more (e.g. over 3 × as much) in 2016, but in 2020 not much more.
	(c)		**Any two from:** Negative effects on animal habitats ✓ Too little wind / too much wind / rough weather ✓ People may not like look of them ✓ Land could be used for housing / offices instead ✓ They can cause noise pollution ✓ Idea of proximity to populated areas ✓	**2**	**3.2a**	**ALLOW** any reference to amount of wind **IGNORE** not enough space

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	 All symbols correct ✓ Two lamps in parallel with cell **AND** no gaps in circuit ✓	2	1.2	**ALLOW** no dots at junctions **ALLOW** battery / multiple cells in series **IGNORE** switch **IGNORE** correctly connected ammeter/voltmeter **ECF** for incorrect symbols used
		(ii)	Observe/record/compare/measure brightness with different numbers of lamps connected in parallel ✓ Keep number of cells/batteries the same ✓	2	1.2	**ALLOW** add more lamps and see if/how brightness changes or WTTE
	(b)		Measure current using an <u>ammeter</u> ✓ Method of changing current/brightness e.g. adding in more bulbs/resistors/cells/using variable resistor (and compare) ✓	2	3.3a	**ALLOW** recognisable spellings

Question			Answer	Marks	AO element	Guidance
4	(a)		An electron in the atom moves closer to the nucleus. ✓	1	1.1	Tick in 2nd box **ALLOW** any unambiguous indication
	(b)	(i)	**First check the answer on answer line** **If answer = 125 (C) award 3 marks** Select: Energy = charge × p.d. ✓ Substitute: 7500 = charge × 60 ✓ = 125 (C) ✓	3	 1.2 2.1 x 2	 **ALLOW** suitable symbol equation **ALLOW** any correct rearrangement **ALLOW** substitution mark if substitution clearly correct with incorrect rearrangement
		(ii)	**First check the answer on answer line** **If answer = 0.8 (A) award 3 marks** Select and substitute: (p.d. across primary × current in primary = p.d. across secondary × current in secondary): 240 × 0.2 = 60 × current ✓ Rearrange: (240 x 0.2) / 60 ✓ = 0.8 (A) ✓	3	2.1	 **ALLOW** suitable symbol equation

Question			Answer	Marks	AO element	Guidance
5	(a)		$^{131}_{53}I$ 131 ✓ 53 ✓	2	2.2	**ALLOW** 131 in either position for first mark and 53 in either position for second mark
	(b)		Ionising radiation so: ✓ **AND any one from:** Can cause cell damage ✓ Can cause cell death ✓ Can cause cell mutation / Damage to DNA ✓ Can cause cancer ✓	2	1.1	**ALLOW** can cause tissue damage **IGNORE** cause tumours
	(c)	(i)	**Any two from:** Alpha /α Beta /β Neutrons ✓	1	1.1	Either order **DO NOT ALLOW** gamma **DO NOT ALLOW** electrons **ALLOW** positrons
		(ii)	(They are) unstable / to become stable ✓	1	1.1	
		(iii)	The charge of the nucleus <u>can</u> change, and the mass of the nucleus <u>can</u> change. ✓	1	1.1	
	(d)		**Any two from:** Other (scientists) evaluate / check publications / data ✓ Try to reproduce results / verify accuracy of claims ✓ The other scientists work in the same area / field of study ✓	2	1.2	

Question			Answer	Marks	AO element	Guidance
6	(a)		Measure the mass of empty measuring cylinder / zero the balance after placing measuring cylinder on balance✓ Add syrup and measure mass of full measuring cylinder ✓ Record volume of syrup using measuring cylinder at eye level ✓ Divide the mass (of syrup) by the volume (of the syrup) ✓	4	2.2	**ALLOW** use of beaker instead of cylinder if beaker also used to measure syrup mass **ALLOW** weigh cylinder/syrup but not measure weight **ALLOW** this mark if mass of full beaker measured **DO NOT ALLOW** if mass measured using beaker **DO NOT ALLOW** volume measured from beaker
	(b)	(i)	**First check the answer on answer line** **If density = 1.3 (g/cm^3) award 4 marks** Volume of block = 1.2 × 2.5 × 1.8 = 5.4 (cm^3) ✓ Select: Density = mass / volume ✓ Substitute: Density = 7.02 ÷ 5.4 ✓ = 1.3 (g/cm^3) ✓	4	**1.2 x 2** **2.1 x 2**	**ALLOW** suitable symbol equation **ALLOW ECF** for use of an incorrect volume for final 3 marks. **ALLOW** max 3 marks if mass converted to kg **ALLOW** max 2 marks if incorrect volume used and mass converted to kg
		(ii)	D ✓	1	3.2b	
		(iii)	It is more dense than the water **AND** less dense than the syrup ✓	1	3.2b	**ALLOW** consistent reverse argument **DO NOT ALLOW** block less dense than oil

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	**First check the answer on answer line** **If answer = 600 (s) award 4 marks** Conversion: 50 mA = 0.05 A ✓ Select: Charge = current × time ✓ Substitute: 30 = 0.05 × Time ✓ Time = 600 (s) ✓	**4**	**1.2 x 2** **2.1 x 2**	**ALLOW** suitable symbol equation **ALLOW ECF** for final 3 marks if current incorrectly converted / not converted **ALLOW** 3 marks for answer of 600 to any other power of 10 with or without working
		(ii)	(current is) a rate of flow of ✓ Charge ✓	**2**	**1.1**	**ALLOW** change in charge ÷ change in time for 2 marks **IGNORE** electrons
	(b)		**First check the answer on answer line** **If answer = 1150 (Ω) award 3 marks** Select: Power = current^2 × resistance ✓ Substitute: 46 = (0.2)^2 × resistance ✓ Resistance = 1150 (Ω) ✓	**3**	**1.2** **2.1 x 2**	**ALLOW** suitable symbol equation **ALLOW** P=IV **and** V=IR for select mark **ALLOW** 46=0.2xV **and** 230=0.2xR for substitute mark
	(c)		**First check the answer on answer line** **If answer = 2760 (J) award 2 marks** Substitute: 11.5 = Energy ÷ 240 ✓ Energy = 2760 (J) ✓	**2**	**2.1**	

Question			Answer	Marks	AO element	Guidance
8	(a)		**First check the answer in table** **If answer = 25.2 (km/h) award 2 marks** 7 / 1000 **OR** 7 x 3600 seen anywhere✓ ((7/1000) x 3600) = 25.2 ✓	**2**	**1.2**	**ALLOW** answer of 25 for 2 marks
	(b)		**First check the answer on answer line** **If answer = 0.24 (m/s^2) award 4 marks** Select: Acceleration = change in speed ÷ time ✓ Substitute: Acceleration = (7 – 3) ÷ 17 ✓ = 0.2352941176 ✓ = 0.24 (m/s^2) ✓	**4**	**1.2** **2.1 x 2** **1.2**	 **ALLOW** 4 ÷ 17 for substitute mark **ALLOW** any answer given to 2dp for final mark
	(c)	**(i)**	 X(bike on road) Y(road on bike) 2 arrows equal length in opposite directions ✓ Correctly labelled, both start close to centre of point where wheel touches road ✓	**2**	**2.2**	**ALLOW** drawn free hand, same length by eye Arrows can be anywhere on the diagram for this first mark
		(ii)	**Any three from:** Weight (of bike) / force due to gravity / gravitational force / force of attraction from earth✓ (Contact/reaction) force of Leo on saddle ✓ Contact/reaction force (of the road on the wheels) ✓ Air resistance/drag (on the bike) ✓ Thrust / (contact) friction between road and tyre ✓	**3**	**2.1**	 **DO NOT ALLOW** weight of Leo **IGNORE** gravity alone **ALLOW** friction as an alternative to drag
	(d)		the downward force on the rucksack due to the gravitational attraction of the Earth ✓	**1**	**1.1**	Tick in 1st box **ALLOW** any unambiguous indication

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	**First check the answer on answer line** **If answer = 4.05 × 10^{-7} (m) award 3 marks** Substitute: 3 × 10^{8} m/s = 7.40 × 10^{14} Hz × wavelength ✓ Wavelength = 4.05405…. x10^{-7} (m) ✓ = 4.05 × 10^{-7} (m) ✓	**3**	**2.1 x 2** **1.2**	**ALLOW** 0.000000405 for 3 marks **ALLOW** any answer given to 3SF for final mark
		(ii)	(Yes because): (4.056 x 10^{-7} is) within the violet range (of wavelengths) / within the violet wavelengths **OR** (4.056 x 10^{-7} is) between 3.90 and 4.25 (x 10^{-7}m) ✓	**1**	**3.1b**	**ALLOW ECF** from 9ai if answer lies within a different range and correct colour/range selected **DO NOT ALLOW** 4.05 × 10^{-7} is below 4.25 x 10^{-7}m alone **DO NOT ALLOW** 4.05 × 10^{-7} is above 3.90 x 10^{-7}m alone
	(b)		Electromagnetic waves are transverse. ✓ Infra-red waves are emitted by molecules. ✓	**2**	**1.1**	Tick in 1st and 3rd boxes **ALLOW** any unambiguous indication Mark independently. If 3 or more ticks treat each additional tick as a contradiction of one correct tick.

Question			Answer	Marks	AO element	Guidance
10	(a)		**First check the answer on answer line** **If answer = 0.0792 (J) award 4 marks** Select: Energy = ½ × spring constant x extension^2 ✓ Calculate compression: 0.17 – 0.05 = 0.12 (m) ✓ Substitute: Energy = 0.5 × 11 × 0.12^2 ✓ = 0.0792 (J) ✓	4	1.2 2.1 x 3	**ALLOW** max 3 marks if incorrect compression used. E.g. using 0.17 m = 0.15895(J) or using 0.05 m = 0.01375 (J)
	(b)	(i)	gravitational (potential) / GPE ✓ kinetic / KE ✓	2	2.1	
		(ii)	conserved / stays the same / no change ✓	1	2.1	
	(c)	(i)	increasing the compression increases the speed (at **Z**) ✓ (because) it increases the (elastic potential) energy stored in the spring ✓ (which) increases the kinetic energy of the ball ✓	3	3.2a	**ALLOW** consistent reverse argument throughout **ALLOW** 1 mark for correct link between elastic potential in spring and KE in ball if no other mark awarded
		(ii)	(changing the height) makes no difference (to the speed at **Z**) ✓ Because all the GPE is transferred back to KE ✓	2	3.2a	2nd mark can only be scored if first mark scored
	(d)		**First check the answer on answer line** **If answer = 0.3 (m) award 3 marks** Select: Energy = mass × gravitational field strength × height ✓ Substitute: 0.06 = 0.02 × 10 × height ✓ height = 0.3 (m) ✓	3	1.2 2.1 x 2	**ALLOW** max 2 marks if mass converted to grams

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