Foundation

GCSE

Combined Science B Twenty First Century Science

J260/03: Physics (Foundation 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. **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 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 **10**

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)		Gamma rays ✓	1	1.1	**ALLOW** gamma waves **ALLOW** γ , gamma
	(b)		A radio wave has a longer wavelength than an X-ray ✓	1	1.1	Tick in 1st box **ALLOW** any unambiguous indication
	(c)		Ionisation ✓	1	1.1	Tick in 3rd box **ALLOW** any unambiguous indication

Question			Answer	Marks	AO element	Guidance
2	**(a)**	**(i)**	B ✓	**1**	**1.1**	
		(ii)	D ✓	**1**	**1.1**	
	(b)		**First check the answer on answer line** **If answer = 8 (m) award 2 marks** Substitution: wavelength = 2.8 / 0.35 ✓ = 8 (m) ✓	**2**	**2.1**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>
<table>
<tr><td>Coal</td><td>(Steam is produced. The steam drives a turbine, which is connected to a generator.)</td></tr>
<tr><td>Wind</td><td>(The energy resource turns the turbine directly. The turbine is connected to a generator.)</td></tr>
<tr><td>Solar radiation</td><td>(Panels are used which generate electricity directly.)</td></tr>
</table>
✓✓
</td><td>2</td><td>1.1</td><td>1 or 2 correct = 1 mark
3 correct = 2 marks</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Renewable – any one from:
tidal / wave / hydroelectric / geothermal / biomass / hydrogen, biofuels ✓

Non-renewable – any one from:
gas / oil / nuclear (fuel) / petrol✓</td><td>2</td><td>1.1</td><td>DO NOT ALLOW wind, solar [question stem] , water (too vague)

DO NOT ALLOW coal [question stem]
IGNORE fossil fuels</td></tr>
<tr><td></td><td>(c)</td><td></td><td>carbon dioxide ✓
fossil fuels ✓</td><td>2</td><td>1.1</td><td></td></tr>
</table>

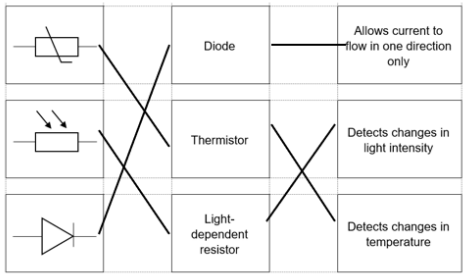
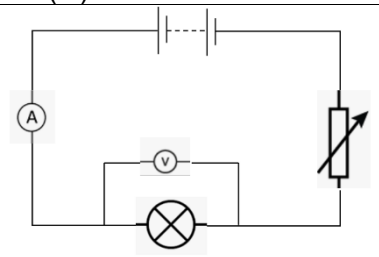
Question			Answer	Marks	AO element	Guidance
4	(a)		**First check the answer on answer line** **If answer = 13.8 (kWh) award 4 marks** Selection: energy transferred = power x time ✓ Conversion: 2300 W = 2.3 kW ✓ Substitution: E = 2.3 × 6 ✓ = 13.8 (kWh) ✓	**4**	**1.2 x 2** **2.1 x 2**	**ALLOW** 3 marks for 13800
	(b)		The idea of the joule being too small / inconvenient or the number on the bill being too big ✓	**1**	**2.1**	**ALLOW** any valid argument e.g. electricity use of appliances is usually watts or kilowatts for hours
	(c)	**(i)**	**First check the answer on answer line** **If answer = 21 000 000 (J) award 3 marks** Selection: change in internal energy = mass x specific heat capacity x change in temperature ✓ Substitution: E = 1 250 × 4 200 × 4 ✓ = 21 000 000 (J) ✓	**3**	**1.2** **2.1 x 2**	**ALLOW** e.g. 2.1×10^7 (J) 21000 kJ, 21 MJ (correct unit needed if different unit used)
		(ii)	**First check the answer on answer line** **If answer = 0.72 award 2 marks** Substitution: Efficiency = 10.8 / 15 ✓ = 0.72 ✓	**2**	**2.1**	**ALLOW** 72% but not 0.72 %
	(d)		Put a cover over the pool / insulate (the walls) ✓	**1**	**2.1**	**ALLOW** other sensible suggestion **DO NOT ALLOW** keep heater on

Question			Answer	Marks	AO element	Guidance
5	(a)		**Any three from:** Mass / volume water ✓ Start temperature ✓ Thickness of insulation ✓ Room/external temperature ✓ Time (for water to cool) ✓ Type of metal used for container ✓	3	3.3a	**ALLOW** amount of water
	(b)	(i)	Shredded paper ✓ Smallest temperature drop /after 5 minutes its temperature is highest ✓ Smallest (rate of) loss of (thermal) energy ✓	3	3.2b	**ALLOW** lowest rate of temperature drop **ALLOW** heat for energy
		(ii)	**First check the answer on answer line** **If answer = 0.037 (°C/s) award 4 marks** Conversion: 5 minutes = 5 × 60 = 300 s ✓ Substitution: Rate = (80 – 69)/300 = 11/300 ✓ = 0.0366 (°C/s) ✓ = 0.037 (°C/s) (2sf) ✓	4	1.2 2.2 x 2 1.2	**ALLOW** 3 marks for answer 2.2 (°C/s)

Question			Answer	Marks	AO element	Guidance
6	(a)		coulomb / C ✓ joule/kilogram OR J/kg ✓ joule / J ✓	3	1.1	**ALLOW** J/g **ALLOW** Nm
	(b)		displacement – vector force– vector speed – scalar ✓✓	2	1.1	All correct = 2 marks 1 or 2 correct = 1 mark
	(c)		**First check the answer on answer line** **If answer = 201 (m) award 3 marks** Rearrangement: distance = average speed x time ✓ Substitution: distance = 13.4 x 15 ✓ = 201 (m) ✓	3	2.1	

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	(mass = 111.4 - 56.2 =) 55.2 (g) ✓	1	1.2	
		(ii)	**First check the answer on answer line** **If answer = 0.92 (g/cm^3) award 2 marks** Substitution: Density = 55.2/60 ✓ =0.92 (g/cm^3) ✓	2	2.2	**ALLOW ECF** mass from **(7ai)**
	(b)	(i)	Density increases ✓ **AND any two from:** The particles become closer together / more closely packed ✓ The mass does not change / is the same ✓ Volume decreases ✓	3	3.1a	**ALLOW** gas compresses **DO NOT ALLOW** area
		(ii)	**Any three from** The air particles / molecules gain (kinetic) energy ✓ And move at higher speeds / faster / have more momentum ✓ (So) collisions with the walls of the container ✓ become more frequent ✓ And harder / cause larger changes in momentum ✓	3	2.1	**ALLOW** more collisions for 2 marks The last two marking points can be scored without the mention of the walls of the container

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	(Extension = 13.6 – 4.0) = 9.6 (cm) ✓	1	1.2	
		(ii)	**First check the answer on answer line** **If answer = 0.42 (N/cm) award 4 marks** Rearrangement: spring constant = weight / extension ✓ Substitution: spring constant = 3.0 / 7.2 ✓ = 0.41667 (N/cm) ✓ =0.42 (N/cm) (2dp) ✓	4	**2.2 x 3** **1.2**	**ALLOW** k = F / x
	(b)		As the weight increases the extension increases ✓ Comparison of data from table or graph ✓	2	1.1	**ALLOW** use of values from the table or graph Candidates must use data from the graph or the table for the 2nd mark. **ALLOW** if data use is implicit. (e.g direct proportion for 2 marks)
	(c)		(As masses lower their) store of Gravitational Potential energy (GPE) decreases ✓ (As the spring stretches) its store of elastic potential energy (EPE) increases ✓ Decrease in GPE store = Increase in EPE store ✓	3	2.1	**ALLOW** elastic energy for EPE **ALLOW** GPE lost = EPE gained **ALLOW** Decrease in GPE store = Increase in EPE store + increase in thermal energy store **ALLOW** other wording suggesting these transfers balance
	(d)	(i)	The energy stored increases by <u>more than two times</u> ✓	1	3.2b	
		(ii)	The energy depends on the extension squared **OR** If the extension is doubled the energy is multiplied by 4 ✓	1	3.2b	**DO NOT ALLOW** ECF from D(i)

Question			Answer	Marks	AO element	Guidance
9	(a)		 ✓✓✓✓	4	1.1	Name: three correct = 2 marks, one correct = 1 mark. Use: three correct = 2 marks one correct = 1 mark.
	(b)	(i)	As potential difference increases current increases ✓ The idea that increases in current become smaller for subsequent 1 V increases in pd **OR** Two increases in current for 1 V increases in pd compared ✓	2	1.2	**ALLOW** graph/line starts to curve when p.d. reaches (about) 2 V or words to that effect **ALLOW** graph becomes non-linear at (about) 2V For example 0 – 1 V: 0.2 A, 1 – 2 V: 0.18 V, 2 – 3 V: 0.13 A, 3 – 4 V: 0.07 A
		(ii)	**First check the answer on answer line** **If answer = 5.5 (Ω) award 4 marks** Selection: potential difference = current x resistance ✓ Use of graph: When V = 2.2 V, I = 0.4 A ✓ Substitution: R = 2.2 / 0.4 ✓ = 5.5 (Ω) ✓	4	1.2 2.2 x 3	
		(iii)	 ✓✓✓	3	1.2	1 mark = correct circuit symbol in correct place in circuit **ALLOW** Ammeter and variable resistor on either side of the circuit **ALLOW** voltmeter drawn in parallel to bulb

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

Question			Answer	Marks	AO element	Guidance
Question			**Answer**	**Marks**	**AO element**	**Guidance**
11	**(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**	

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