Higher

GCSE

Physics B Twenty First Century Science

J259/04: Depth in 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.

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.

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 questions on this paper are **1b(ii)** and **6**

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 Physics 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)	(i)	230 V a.c. ✓	1	1.1	
		(ii)	**Any two from:** Reduced/smaller current (for the same power) ✓ So less heating of the cables ✓ Less power (as $P = IV$) dissipated ✓	2	1.1	**ALLOW** less energy transferred to surroundings /less energy wasted /less power lost
		(iii)	(step down) transformer	1	1.1	
	(b)	(i)	**Any two from:** wind✓ solar✓ hydroelectric✓ tidal ✓ wave✓ biomass ✓ geothermal ✓	2	1.1	**IGNORE** sun **IGNORE** water **ALLOW** examples of Biomass
	*	(ii)	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)** Description of the trends from the charts **AND** Gives a reason for the trends *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	6	**2 x 1.1** **2 x 3.1a** **2 x 3.2a**	**AO1.1 – Demonstrates knowledge and understanding of renewable and non-renewable energy resources** Reasons for the trends: • Renewables will not run out / can be replaced in our lifetime • Non-renewables will run out / cannot be replaced in our lifetime • Coal, oil, gas, nuclear are non-renewable **AO3.1a – Analyses the information and ideas to describe some trends in the use of energy resources** • In general, use of non-renewables decreases

Question			Answer	Marks	AO element	Guidance
			Level 2 (3–4 marks) Description of the trends from the charts **OR** Gives reasons for the trends **OR** A description of a trend from the chart and gives a reason for the trend *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 description of a trend from the chart **OR** Gives a reason for a trend *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*			• In general, use of renewables increases • Reduction in fossil fuels % use is greatest • No change in use of nuclear / oil **AO3.2a – Analyses the information and ideas to make judgements about the use of energy resources** **ORA** all points • Using less non-renewables conserves resources • More renewables used as non-renewables are running out • Non-renewables produce less CO_2 / do not contribute as much to global warming • UK commitment to use more non-renewable sources • Evidence now accepted that CO_2 a major factor in global warming • Use of (UK generated) nuclear unchanged as less CO_2 but public worried about nuclear accidents / difficulty of disposing nuclear waste • Coal reduction greatest as it produces CO_2 / acid rain / ash • Cannot totally remove the use of non-renewables as renewables are not reliable / storage needed • Improved technology has increased power generated from renewables

Question			Answer	Marks	AO element	Guidance
2	(a)		50.5 (cm^3)	1	2.2	**ALLOW** Range 50-51
	(b)	(i)	20 (g)	1	3.1b	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.2 (g/cm^3) award 4 marks** Choose a pair of corresponding readings for mass and volume from the graph ✓ **AND** Subtracts 20g from the mass ✓ Apply density equation ✓ 1.2 (g/cm^3) ✓ **OR** Choose a second pair of corresponding readings for mass and volume from the graph ✓ Use equation for determining gradient ✓ 1.2 (g/cm^3) ✓	4	2.1	**ALLOW ECF** use of volume from (a) with 80 g (80g-20g)/their volume cm^3 ✓✓✓ = their correct answer ✓ **ALLOW** readings within ½ square read from the graph **ALLOW** values for mass and volume from the graph without subtracting 20g e.g. 80/50 =1.6 (g/cm^3) can be indicated on graph 2 marks **ALLOW** 2 marks for 1.4 with no working **ALLOW** answers that round to 1.2 (g/cm^3) **ALLOW** answers that round to 1.2 (g/cm^3)

Question			Answer	Marks	AO element	Guidance
3	(a)		**Any two from:** New particles were discovered ✓ Experiments provided new evidence✓ Models/theories fitted best evidence at that time/new evidence doesn't fit with existing theory ✓ more advanced technology/techniques allow for more detailed experiments ✓	**2**	**1.1**	**ALLOW** named examples of new evidence and theory
	(b)		**Any three from:** Positive nucleus✓ Nuclear radius very small (compared to atom) ✓ Most of the mass is in the nucleus ✓ Nucleus consists of protons and neutrons✓ Electrons in shells/allowed orbits ✓	**3**	**1.1**	**ALLOW** the nucleus is very small **ALLOW** most of an atom is empty space/nucleus is dense **IGNORE** nucleus surrounded by electrons

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	**Any one from:** Open the switch between readings ✓ Disconnect the circuit between readings ✓ Reduce the current by increasing the resistance of the variable resistor ✓	1	3.3b	**ALLOW** turn off the battery/power supply between readings **IGNORE** ref. to adding more batteries/more powerful battery
		(ii)	**Any three from:** Chemical store in battery/power supply✓ (Electrical) Work done by potential difference on electrons/charges/work done = potential difference x charge✓ Electrical Energy transferred to the lamp ✓ Increases internal energy store in lamp (filament) ✓ Thermal energy transferred to surroundings (via radiation)✓ increases energy store of surroundings ✓	3	1 x 1.1 2 x 2.1	**ALLOW** Energy transferred (to the lamp) via electrons/current/moving charges **ALLOW** increases thermal energy store in lamp/wire (filament) **ALLOW** heat for thermal energy
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9.75 (W) award 3 marks** Read current from graph = 1.95 (A) ✓ Select and apply Power = pd x current = 5 x 1.95✓ = 9.75 (W) ✓	3 **2.2** **1.2** **2.2**		**ALLOW** value of current read from graph 1.9 (A) to 2.0 (A) **ALLOW** 9.5 (W) to 10.0 (W)

		(ii)	Correctly reads V and I for two points from either V≤4.0(V) and V ≥5.0V✓ Rearranges equation and substitutes for one point correctly ✓ Calculates a correct value for R (Ignore unit) ✓ Calculates correct second value for R and so agrees with the student/as pd increases resistance increases✓	**4**	**3 x 2.1** **1 x 3.2b**	Possible answers R = 2/0.8 = 2.5 Ω R = 4/1.6 =2.5Ω R = 5/1.95 = 2.6Ω R = 6/2.2 = 2.7Ω R = 8/2.55 = 3.1Ω R = 10/2.7 = 3.7Ω **ALLOW** values read from the graph correct to ½ square **DO NOT ALLOW** final mark without correct unit for resistance shown at least once in answer
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 11.9V award 5 marks** Converts kJ to J ✓ Charge = 2.8 × 120 = 336 (C) ✓ Rearrange and apply equation 4000 / 336 ✓ 11.904761… V ✓ 11.9 V ✓	**5**	 **1.1** **3 x 2.2** **1.1**	 **ALLOW** incorrect or no unit conversion to give 11.9x10^{n} 3 marks **ALLOW** any calculated value given correctly to 1d.p.

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	(0-25s) Uniform/constant acceleration/0.56 m/s^2 ✓ (25-200s) Uniform/constant speed (14m/s) or 0 acceleration✓	2	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.28 (m/s^2) award 3 marks** Select and apply: $\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$ ✓ Use change in time = 50 (s) ✓ = 0.28 (m/s^2) ✓	3	**1 x 1.1** **2 x 2.2**	(a=)14/50 award MP1 and MP2 **IGNORE** signs
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 175 (m) award 2 marks** Use area under graph **or** 0.5 x 14 x 25 ✓ = 175 (m) ✓	2	2.2	**ALLOW** attempt to count squares
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8.3 (h) award 4 marks** Rearrange equation $\text{time} = \frac{\text{energy transferred}}{\text{power}}$ ✓ =58/7 **or** 58000/7000 ✓ = 8.286 ✓ =8.3 (h) (to 2sf) ✓	4	**3 x 2.2** **1 x 1.2**	**ALLOW** a correctly calculated value of time to 2sf
		(ii)	Electric car 58 x 34p (= 1972p =£19.72) ✓ Petrol car 32 x 145 (= 4640p = £46.40) ✓ 2 x £19.72 < £46.40 **or** half of £46.40/£23.20 > £19.72 **or** it costs Sara 2.4 times more than Zayn/Zayn 0.4 times less than Sara ✓	3	3.1b	**IGNORE** comparison of the difference between costs

Question			Answer	Marks	AO element	Guidance
6	*		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)** Compares the properties and hazards of the three types of radiation **AND** Describe how damage to cells is reduced *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 the properties of the types of radiation **AND** Gives some understanding of hazards for the types of radiation *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 the properties of the types of radiation **OR** Gives some understanding of hazards for the types of radiation	**6**	**2 x 1.1** **2 x 2.1** **2 x 3.2a**	**AO1.1 Demonstrates knowledge and understanding of the types of ionising radiation** **Alpha** Range 7 cm stopped by paper/skin Amount of ionisation High **Beta** Range 1-2 m stopped by metal /aluminium range reduced in tissue Amount of ionisation medium **Gamma** Range infinite reduced by thick lead/concrete Amount of ionisation low **AO2.1 – apply knowledge and understanding of penetrating properties of radiation to destruction of unwanted tissue** All ionising radiation damages /cells DNA Use low ionising radiation minimise damage Radiation damage reduced by short exposure time Alpha radiation cannot travel far enough in air to reach patient Alpha radiation could not pass through skin Beta radiation would be partially absorbed by skin and healthy tissue. Beta ionising properties could cause damage to skin and heathy tissue. Gamma would pass through skin and healthy tissue.

Question			Answer	Marks	AO element	Guidance
			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.*			Gamma no problem with range The beam is rotated so not concentrated on one area of the body/cells which minimises damage to healthy cells The radiation beam is focused directly at the cancer and no healthy tissue Radiation reduces rapidly with distance (inverse sq law) **AO3.2a – Analyses the information and ideas to make judgements about the use of radiation sources in cancer treatment** Alpha or Beta cannot be used Gamma is suitable

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th></th><th>Is liquid</th><th>Is solid</th><th>Cannot tell</th></tr>
<tr><td>mantle</td><td></td><td>✓</td><td></td></tr>
<tr><td>outer core</td><td>✓</td><td></td><td></td></tr>
<tr><td>Inner core</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>3</td><td>3.2b</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>the speed of the wave changes (with density) ✓

causing the wave to change direction ✓</td><td>2</td><td>1x1.1

1x2.1</td><td>ALLOW speed increases/decreases for speed changes/changes wavelength
ALLOW refracts</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Any three from:
Magnetic field lines are cut ✓
There is a changing magnetic field (inside the coil) ✓
(So) pd is induced (across the ends of the coil)✓
The coil is in a closed circuit ✓
(So) there is a (induced) current (in the coil) ✓</td><td>3</td><td>3 x 2.1</td><td>

ALLOW voltage</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Magnet cuts through no/fewer coils ✓
Either
(Induced) pd is 0/smaller ✓
OR
the (induced) current is 0/smaller ✓</td><td>2</td><td>1 x 1.1

1 x 2.1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Any one from:
More turns/coils ✓
Stronger magnet✓</td><td>1</td><td>1x3.3a</td><td>
IGNORE bigger coil
IGNORE bigger magnet</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	(a quantity) that has both size/magnitude and direction	1	1.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 21000 kgm/s award 3 marks** Select and apply Momentum = mass x velocity = 1500 x 14 ✓ = 21000 ✓ kg m/s ✓	3	 1.2 2x 2.1	 **ALLOW** Ns
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.028 (s) award 4 marks** Select and rearrange time = $\frac{\text{change in momentum}}{\text{resultant force}}$ ✓ Uses change in momentum = 21000 (kg m/s) ✓ (Time) = 21000 / 750 000 ✓ = 0.028 (s) ✓	4	 1.2 3x 2.1	 **ALLOW ECF** from (a)(ii) Correct substitution gains MP1, MP2 and MP3
	(b)		calculation of efficiency for A = $\frac{199-146}{199}$ ✓ = 0.27✓ Crumple zone of car C is the most efficient ✓	3	3 x3.1b	 **ALLOW** 0.26/26%/27% efficient Evidence of a correct calculation for efficiency of Car A needed for this mark

Question			Answer	Marks	AO element	Guidance
9	(a)		The temperature of the Sun is greater than Venus **ORA** ✓ (And) wavelength is dependent on temperature/the shorter the wavelength the greater energy (emitted) **ORA** ✓	**2**	**2 x2.1**	 **ALLOW** wavelength from the Sun is shorter because it has a greater temperature **ORA** ✓ ✓ **ALLOW** higher frequency for shorter wavelength (linked to temperature) **ORA**
	(b)		Wavelength = 4 x10^{-6}m converted from graph ✓ Select and apply: Speed = wavelength x frequency/v=λf ✓ (Frequency) = 3x10^{8} /4 x 10^{-6} ✓ Frequency = 7.5x10^{13} (Hz) which is in the infrared range ✓	**4**	**1.1** **3x 3.2a**	**IGNORE** 4μm (Frequency) = 3x10^{8} /4 x 10^{n} gains MP2 and MP3 **ALLOW** 3 marks out of 4 for power of 10 error provided conclusion consistent e.g. 3x10^{8}/4 = 7.5 x 10^{7} (Hz) consistent with radio and microwaves
	(c)		**Any three from:** Shorter wavelengths/visible or UV (from the Sun pass through Venus' atmosphere)✓ Venus absorbs (EM) radiation ✓ Venus (re-)emits longer wavelengths/infrared (radiation)✓ (longer wavelengths/infrared) absorbed by the CO_2 ✓ And re-emitted in all directions (keeping Venus warmer) ✓	**3**	**2.1**	**ALLOW** responses referencing the earth and Sun **ALLOW** higher frequency for shorter wavelength or vice versa **IGNORE** heat/IR is trapped/CO_2 absorbs radiation emitted from the Sun/reflection of radiation **ALLOW** given off for re-emitted

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on

01223 553998

Alternatively, you can email us on

support@ocr.org.uk

For more information visit

ocr.org.uk/qualifications/resource-finder

ocr.org.uk

Twitter/ocrexams

/ocrexams

/company/ocr

/ocrexams

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT

OCR is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

OCR operates academic and vocational qualifications regulated by Ofqual, Qualifications Wales and CCEA as listed in their qualifications registers including A Levels, GCSEs, Cambridge Technicals and Cambridge Nationals.

OCR provides resources to help you deliver our qualifications. These resources do not represent any particular teaching method we expect you to use. We update our resources regularly and aim to make sure content is accurate but please check the OCR website so that you have the most up-to-date version. OCR cannot be held responsible for any errors or omissions in these resources.

Though we make every effort to check our resources, there may be contradictions between published support and the specification, so it is important that you always use information in the latest specification. We indicate any specification changes within the document itself, change the version number and provide a summary of the changes. If you do notice a discrepancy between the specification and a resource, please contact us.

Whether you already offer OCR qualifications, are new to OCR or are thinking about switching, you can request more information using our Expression of Interest form.

Please get in touch if you want to discuss the accessibility of resources we offer to support you in delivering our qualifications.