Foundation

GCSE

Physics B Twenty First Century Science

J259/02: Depth in 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.

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 **7** and **11bii**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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)		Steel ✓	1	1.1	
	(b)	(i)	It is attracted to the S-pole ✓	1	2.1	
		(ii)	It is attracted to the N-pole ✓	1	2.1	
	(c)		**Any two from:** Allow compass needle to swing freely away from any other magnetic field ✓ Move to different places ✓ Needle will (always) point North ✓ (because) needle will align to the Earth's magnetic field ✓	2	3.3a	 **ALLOW** Rotate the compass **ALLOW** same direction **ALLOW** (magnetic) pole/field (of Earth) will attract it

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	voltmeter✓ ammeter✓	2	2 x 1.2	**ALLOW** Either order **DO NOT ALLOW** ampmeter
		(ii)	To change the potential difference across X. ✓	1	1.2	
		(iii)	**Any one from:** Open the switch between readings ✓ Disconnect the circuit between readings ✓ Reduce voltage/current/power ✓	1	3.3b	**ALLOW** any reasonable method of cooling e.g. Use a fan to cool X **ALLOW** don't leave it switched on **ALLOW** any reasonable method that decreases power to X
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.5 (Ω) award 3 marks** Rearrange equation $R = V \div I$ **OR** correct substitution in unarranged equation✓ 4 ÷ 1.6 ✓ 2.5 (Ω) ✓	3	2.2	**ALLOW** use of incorrect value from graph
		(ii)	Graph is not a straight line/AW ✓	1	3.1a	**ALLOW** Graph is a curve **ALLOW** not (directly) proportional
		(iii)	Lamp	1	3.2b	**ALLOW** bulb

Question			Answer	Marks	AO element	Guidance
3	(a)		positive ✓ nucleus✓ much smaller ✓	3	1.1	
	(b)		**Any two from:** (Both have) same number of protons ✓ (Both have) same number of electrons ✓ Number of protons = number of electrons ✓ They both have an overall neutral charge ✓ The nuclei are positively charged in both ✓ Different number of neutrons/nucleons ✓ Different mass ✓	2	2.1	**IGNORE** number of shells **IGNORE** position of electrons **ALLOW** same atomic/proton number **ALLOW** both have one electron in outer shell **AW** e.g. B has one less neutron **ALLOW** different mass number
	(c)		Experiments have provided new evidence. ✓ New particles have been discovered. ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	10 (m) ✓	1	1.1	**ALLOW** -10(m)
		(ii)	2 ✓	1	1.1	
		(iii)	3 (s) ✓	1	1.1	
		(iv)	0.33 (Hz) ✓	1	2.1	**ALLOW** 0.3 **ALLOW ECF** from (a)(iii) with their answer correct to 1sf.
	(b)		halves✓	1	2.1	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 15 (cm/s) award 3 marks** Select and apply: wave speed = wavelength × frequency ✓ 2 × 7.5✓ 15 (cm/s) ✓	3	 **1 x 1.1** **2 x 2.1**	

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	electron✓	1	1.1	
		(ii)	negative✓	1	2.1	
	(b)		attracts✓	1	2.2	**ALLOW** rod moves towards it **IGNORE** it becomes neutral
	(c)		**Any two from:** Metal (foil) conducts (charges) ✓ Charges/electrons move from metal ✓ Charges/electrons move onto rod✓ (Charges/electrons move) from person/Earth ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	Constant speed✓	1	2.1	**ALLOW** travels at 22 m/s **ALLOW** (stays) the same speed
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6 (m/s^2) award 3 marks** Reads change in speed = 12 (m/s) **or** change in time = 2 (s) from the graph✓ 12/2 ✓ 6 (m/s^2) ✓	3	2.1	
		(iii)	Less acceleration between A and B **ORA**✓ **Max two** marks from **one** pair: (because) graph is not so steep / gradient is less ✓✓ (because) less change in speed for more time taken ✓✓ (because) between C and D the car increases in speed by 12m/s in 2s ✓ (but) between A and B a change in time of 2 s is a smaller increase in speed✓ (because) between A and B the car increases in speed by 10 m/s in 3s ✓ (but) between C and D a change in speed of 10 m/s takes less time ✓	3	2 x 2.1 1 x 3.2a	**ALLOW AW e.g.** lower or higher **ALLOW** calculation of acceleration between A and B = 10/3 = 3.333 (m/s^2) ✓✓ with comparison to a(ii) ✓ **ALLOW ECF** from a(ii) **ORA** **ALLOW** only about 7 m/s increase **ORA** **ALLOW** only about 1.7 s / less than 2 s / 2s

	Question		Answer	Marks	AO element	Guidance
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 91 (km/h) award 3 marks** Convert 4 hours 30 minutes to 4.5 hours ✓ Select and apply equation 410÷4.5 ✓ 91(.1) (km/h) ✓	3	 **1 x 1.2** **2 x 2.1**	**ALLOW** correct answer in m/s, km/s, km/min if given with correct units. **ALLOW** this mark for a correct time conversion to minutes = 270 or seconds = 16200, **ALLOW** this mark for incorrect time conversion e.g. 410÷4.3 or incorrect time unit e.g 410÷270
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 56 (kWh) award 2 marks** energy transferred = 7 × 8 ✓ =56 (kWh) ✓	2	2.1	**ALLOW** 201 600 000 ✓ **ALLOW** 201 600 000 J ✓✓ **ALLOW** 7000 for 7 **ALLOW** 8×60 or 480 or 8×3600 or 28800 for 8
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (£)19.04 award 2 marks** 56 × 34 (= 1904 (p)) ✓ (£)19.04✓	2	 **1 x 2.1** **1 x 1.1**	**ECF** from part (c)(i) **ALLOW** 56 × 0.34 **ALLOW** (£)19
				15		

Question			Answer	Marks	AO	Guidance
7	*		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)** Suggests a change to improve apparatus **and** a change to improve validity of measurements **AND** Gives an explanation for one or both of the improvements. *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)** Suggests one change to improve apparatus and/or validity of measurements **and** gives an explanation for the change **OR** Suggests changes to improve apparatus and/or validity of measurements *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)** Suggests one change to improve apparatus **or** validity of measurements *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**	**2 x 3.1b** **2 x 3.3a** **2 x 3.3b**	V = To improve validity of the measurements **AO 3.3a Analyse information to develop experimental procedures** • Repeat same experiment V • Reason: to check for mistakes/anomalous results / more reliable conclusion if results the same • Have someone else repeat the experiment V • Reason: checks it is reproducible/ more reliable conclusion if results the same • Perform the experiment again using different equipment V • Reason: more reliable if the conclusion is the same • Use smaller steps in current/voltage readings V • Reason: to see trend/ plot graph, to obtain a greater range in mass • Use a larger range in current/voltage • Reason: to obtain a greater range in mass • Plot a graph of results V • Reason: to check for mistakes/anomalous results • Record total mass not number of 10g masses • Reason: to see the variation at low masses **AO 3.3b Analyse information to improve experimental procedures** To improve the apparatus • Use more coils/turns V • Reason: Makes a stronger magnet • Use smaller masses / pins / iron filings • Reason: increases resolution / allows for smaller changes to be detected

Question			Answer	Marks	AO	Guidance
						• Use a power supply/battery allowing larger range of current/voltage • Reason produces greater range of results/ make magnet stronger/can increase range in mass • Use mass holder with less mass • To increase range and resolution allows smaller masses to be detected • Use mass holder with the same mass as masses used • Reason: this can act as first mass **IGNORE** higher current as a reason for increased voltage - needs reason for higher current **IGNORE** change power / use fixed power supply

Question			Answer	Marks	AO element	Guidance
8	**(a)**	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 7050 (N) award 2 marks** 1500 × 4.7 ✓ 7050 (N) ✓	**2**	**2.1**	
		(ii)	Deceleration – decreases ✓ Stopping time – increases ✓	**2**	**3.1a**	
	(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer =2.8 (m/s^2) award 2 marks** 14 ÷ 5 ✓ 2.8 (m/s^2) ✓	**2**	**2.1**	
		(ii)	2.5 (s)	**1**	**3.1**	If answer space blank check table

Question			Answer	Marks	AO element	Guidance
9	(a)		**MAX 3** **Any three from:** A reference to Chemical store / Internal store / thermal store ✓ **OR** From chemical store ✓✓ To Internal store / Thermal store ✓✓ **AND** (Transferred) by (electric) current / electrical working / electrically (from battery)✓ (Transferred) by heating (from heater/case/hand to case/hand/surroundings)✓	**3**	**1 x 1.1** **2 x 2.1**	**IGNORE** kinetic and other stores **ALLOW** energy for store **ALLOW** kinetic store of particles for internal/thermal energy **ALLOW** thermal store for internal energy store **ALLOW** hand warmer for case **ALLOW** any heating transfer between appropriate parts of the system/surroundings **ALLOW** 'by heat' for heating
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5520 (J) award 4 marks** Select Energy = mass × SHC × change in temp ✓ temperature change = 30 ✓ Apply: change in energy = 0.2 × 920 × 30 ✓ = 5520 (J) ✓	**4**	**1 x 1.2** **3 x 2.2**	 **ALLOW** this mark if temperature instead of temperature change e.g. 0.2 × 920 × 50 **ALLOW** this mark for an incorrect temperature change e.g. 0.2 × 920 × 80

Question			Answer	Marks	AO element	Guidance
10	(a)		Velocity is (directly) proportional to distance **ORA**✓	1	3.1a	**ALLOW** As distance increases velocity increases at a constant rate. **ORA** **ALLOW** As distance doubles velocity doubles **ORA**
	(b)		**Any three from:** (Most/Distant) galaxies are moving away (from Earth) ✓ Furthest galaxies are moving the fastest ✓ The universe/space is expanding ✓ Galaxies/everything must have been much closer together in the past ✓ (Distant) galaxies all moving apart Galaxies/everything started from a single point✓	3	1.1	**NOT** stars/planets

Question			Answer	Marks	AO element	Guidance
11	(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 • In general, use of renewables increases

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*			• 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
12	(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)

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