

Foundation

GCSE

Physics B Twenty First Century Science

J259/02: Depth in physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

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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.

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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 are **6** and **12**

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**.

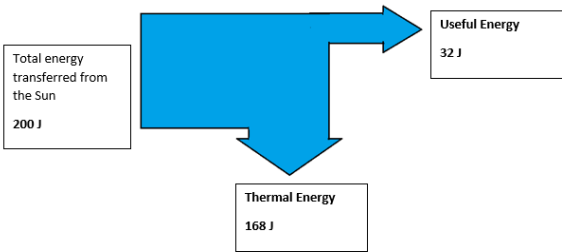
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

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)		23✓ 12✓	2	2.1	
	(b)		Wet road – braking distance ✓ Alcohol – thinking distance✓ Speed – both✓ Mobile phone – thinking distance✓	4	1.1	ALLOW 2 lines speed – braking distance AND speed - thinking distance OR 3 lines speed - all 3 options

Question			Answer	Marks	AO element	Guidance
2	(a)		C✓	1	2.1	
	(b)	(i)	B and D✓	1	2.1	
		(ii)	(Two cells) give twice/double the pd ✓ (And two resistors) give twice/double the resistance (therefore same ratio) ✓	2	3.1a	ALLOW $I = V/R$ is the same (for both circuits) OR Same ratio of cells to resistors for 2 marks ALLOW (because there are) the same amount of cells as resistors 1 mark

Question			Answer	Marks	AO element	Guidance
3	(a)		Solar panels generate more electricity when its sunny ✓ Solar panels use a renewable source of energy to generate electricity ✓	2	1.1	
	(b)	(i)	200 - 32 = 168 (J) ✓	1	2.2	
		(ii)	 <p style="text-align: right;">✓</p>	1	2.2	ALLOW correct numerical values OR correct word labels OR a mixture of word labels and numerical values for output energies. ALLOW 200(J) 32 (J) 168 (J) ALLOW 'Energy Transfer to surroundings' for 'Thermal Energy' ALLOW ECF from b(i) for 168 (J)
		(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.16 award 2 marks $\text{efficiency} = 32 \div 200$ ✓ $= 0.16$ ✓	2	2.1	ALLOW ECF for Useful energy and Total energy from b(ii) ALLOW 16 % for 2 marks provided % sign given
	(c)	(i)	Electromagnetic ✓	1	1.1	
		(ii)	Infrared ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
4	(a)		X= Ammeter✓ Y= Voltmeter ✓	2	1.2	
	(b)		To change the potential difference and the current. ✓	1	1.2	
	(c)	(i)	Two remaining points plotted within 0.5 square✓ Best straight line drawn through candidate's points✓	2	2.2	Must include (0,0) ALLOW if no candidate points
		(ii)	Expected reading 0.35A ✓	1	2.2	ALLOW reading from their line within 0.5 square
		(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 20 (ohm) award 3 marks Selecting suitable pair of readings from graph/table✓ Resistance = $10 \div 0.5$ ✓ =20 (ohm) ✓	3	2.2 2.1x2	ALLOW ecf for use of any point on their line ALLOW use of 7V and their value for current from (c) (ii)
	(d)		Measure/use different lengths of wire ✓ (and) measure the current and potential difference (to calculate the resistance) OR (and) use an ohmmeter/multimeter (to measure the resistance) ✓	2	3.3a	ALLOW suggested lengths e.g. 10cm 20cm ALLOW increase length of wire ALLOW use longer wire(s) ALLOW Use different lengths of wire AND and repeat the experiment OR and calculate the resistance OR and measure the resistance = 2 marks

Question			Answer			Marks	AO element	Guidance
5	(a)		Statement	True	False	2	1.2	4 correct = 2 marks 2 or 3 correct = 1 mark 1 or 0 correct = 0 marks
			A protractor is used to measure angle i.	✓				
			The normal line needs to be drawn at a 45 degree angle to the side of the prism.		✓			
			The prism needs to be moved to measure the angle of refraction. .	✓				
			Angle, i, is always the same as angle r		✓			
	(b)		✓✓ Hazard – Ray box gets hot OR Hazard – semi-dark environment ✓ Reducing risk – Do not touch the bulb/allow time to cool OR Reducing risk – Make sure the environment is clear of trip hazards ✓			2	3.2a 3.3b	

Question			Answer	Marks	AO element	Guidance
	(c)		<p>Any two from:</p> <p>(The angle of refraction) r is smaller than (the angle of incidence) i ORA ✓</p> <p>As (angle of incidence), i, increases (the angle of refraction), r, increases ✓</p> <p>(The angle of refraction) r does not increase as much after (an angle of incidence of) $i \sim 50^\circ$ OR the difference between i and r increases as i increases OR r is not proportional to i ✓</p>	2	3.2b	<p>NOT r is proportional to i</p> <p>ALLOW a correct description of the graph e.g. the graph curves</p>
	(d)		C ✓	1	1.1	
	(e)		<p>Any one from:</p> <p>Red light refracts less than Blue light ORA ✓</p> <p>Red light has a longer wavelength than blue light ORA ✓</p> <p>Red light travels faster OR blue light slows down more in the prism/glass ORA</p>	1	1.1	<p>ALLOW Red light has a different wavelength to blue light</p> <p>ALLOW Red light has a different speed in the prism OR glass OR to blue light</p>

Question	Answer	Marks	AO element	Guidance
6 *	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) A simple description of the method. OR A description of one or more of the variables or control variables for which results will be collected correctly identified AND States a correct conclusion which may include the idea of proportionality. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) An attempt to describe a method. OR A description of some variables and/or controlled variables for which results will be collected. AND States a correct conclusion. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Attempt to describe a simple method. OR Description of a variable or controlled variable for which results will be collected. OR States a simple conclusion. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	3 x 1.2 3 x 3.2b	<p>AO1.2 Demonstrate knowledge and understanding of a scientific procedure</p> <p>Variables</p> <ul style="list-style-type: none"> • Independent – Number of turns • Dependent – Number of pins • Controlled – Distance electromagnet is from pins OR current OR pd OR Material of core OR same wire OR number of cells <p>Method (possible example)</p> <ul style="list-style-type: none"> • Step 1 - start with 20 turns • Step 2 - close switch • Step 3 -count number of pins picked up • Step 4 - open switch and put pins back in dish • Step 5 - Add 10 turns and repeat steps 2 to 4 • Step 6 stop after 60 turns <p>AO3.2b Analyse information and ideas to draw conclusions</p> <p>Conclusion</p> <ul style="list-style-type: none"> • The results show that increasing number of turns increase number of pins • More pins = stronger magnetic field • (therefore) More turns – stronger magnetic field • More pins – greater attractive force • The results show a doubling of number of turns doubles the number of pins, • therefore, shows proportionality/linearity

Question			Answer	Marks	AO element	Guidance
7	(a)		Chemical ✓ Kinetic ✓	2	1.1	
	(b)		Any one from: Gravitational (store) to kinetic (store) ✓ (Kinetic store) to thermal (store) ✓ (From kinetic store transferred by) Sound ✓ (From kinetic store transferred by) light/radiation ✓ (From kinetic store transferred by) mechanical working ✓	1	1.1	ALLOW heat for thermal (i.e. friction between rocket and atmosphere)
	(c)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 15 000 000 000 (J) award 3 marks Converting 12.5km to 12500m✓ Substitution GPE = 120 000x 10 x 12500 ✓ GPE = 15 000 000 000 (J) / 1.5×10^{10} (J)✓	3	1.2 2.1 x 2	ALLOW 15 000 000 (J) / 1.5×10^7 (J) for 2 marks

Question			Answer	Marks	AO element	Guidance
8	(a)		The diagram shows a chain reaction✓ Neutrons are absorbed by the U-235 nuclei✓ At each stage the number of nuclei doubles✓	3	2.1	
	(b)		90 ✓ 39 ✓	2	2.2	
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 29 (years) award 2 marks using activity = 50 % ✓ 29 (years) ✓	2	2.2	line on graph at activity = 50% ALLOW use of 25% if time ÷ 2 ALLOW 28 - 32
		(ii)	8 - 9 (%) ✓	1	2.2	ALLOW 6 -10 (%)
	(d)	(i)	38 ✓	1	2.1	
		(ii)	50✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	Any one from: To compare the ages of the Earth and the Moon ✓ To compare the composition/types/structure of rocks from the Moon to the Earth ✓ Compare the densities of the rocks ✓ To look for evidence on the Moon for: Its composition ✓ How it formed ✓ Water ✓ Life ✓ That we could live there ✓ Resources we could use ✓	1	3.2a	IGNORE compare the similarities and differences of the rocks on the Earth and the Moon ALLOW to identify the rocks on the Moon
		(ii)	Any two from: Fame/personal ambition ✓ Personal curiosity ✓ For scientific knowledge/research ✓ To collect samples for research/interest ✓ Duty to their country ✓ Money ✓ Thrill seeking / excitement ✓	2	3.2a	e.g. understand more about the Moon OR Explore the Moon e.g. Bring Moon rock to Earth
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3.2 (g/cm³) AND Peridotite award 4 marks Select equation: Density = mass ÷ volume ✓ Density = $31 \div 9.7$ ✓ = 3.2 (g/cm ³) ✓ Type of Rock = Peridotite ✓	4	1.2 2.1 x 2 3.1b	ALLOW Density values that round to 3.2 (g/cm ³) ALLOW ECF if Density wrong but in range 2.1-5.3

Question			Answer	Marks	AO element	Guidance
11	(a)		(Changing temperature) changes (kinetic) energy/speed of particles/internal energy ✓ (Hence) a change in the number of collisions with (the area of) piston ✓	2	1.1 2.1	IGNORE particles vibrate more/less ALLOW increase/decrease for change IGNORE reference to rates of reaction
	(b)		Arrow drawn perpendicular to piston surface pointing left ✓	1	2.1	ALLOW a correct arrow drawn near or in the piston
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 16.8 (N) award 3 marks Select: Pressure = Force ÷ Area OR Force = 4.2(N) at V=8.0(cm ³) ✓ Force = 4.2 x 4 ✓ Force = 16.8 (N) ✓	3	1.2 2.1 x 2	
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 34 (Ncm) award 3 marks Constant = 4.0 x 8.4 ✓ = 33.6 ✓ = 34 (to 2sf) ✓	3	2.1 x 2 1.2	ALLOW any pair of volumes from table ALLOW an incorrect calculated value to 2sf
		(iii)	Any three from: As volume increases the pressure decreases ✓ As volume doubles the pressure halves/PV = constant ✓ Supporting data e.g. when volume = 4cm ³ pressure = 8.4N/cm ² and when volume = 8cm ³ pressure = 4.2N/cm ² OR PV = 33.6(Ncm) for at least two pairs of values ✓	3	3.2b	ALLOW Volume is inversely proportional to pressure 2 marks

Question	Answer	Marks	AO element	Guidance
12 *	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) An evaluation of the choice of radioisotopes to use as a tracer AND Description of a risk and a benefit of radioisotopes in medicine <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) A simple evaluation of the choice of a radioisotope to use as a tracer AND Description of a risk or a benefit of using radioisotopes in medicine <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) A simple evaluation of the choice of a radioisotope to use as a tracer OR Stated a risk or a benefit of using radioisotopes in medicine <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i></p>	6	2 x 1.1 2 x 2.1 2 x 3.2a	<p>AO3.2a Analyse information and ideas to make judgements on what type of radiation each isotope emits</p> <ul style="list-style-type: none"> • A and D = Gamma as only reduced by lead • B and E = Beta as stopped by aluminium • C = Alpha as stopped by skin <p>AO2.1 Apply knowledge and understanding of the properties of radioisotopes</p> <ul style="list-style-type: none"> • radioisotope D best choice with reasons e.g. requires short Half-life (B-D) so does not remain active for long but long enough to be used and must be able to pass out of skin easily to be detected so ideally Gamma/ not stopped by skin or aluminium (AD) • Beta would be partially absorbed so could cause damage to tissues / might not exit to give an image <p>AO1.1 Demonstrate understanding of associated risks and benefits of radiation</p> <ul style="list-style-type: none"> • All radiation is ionising • Damages/mutates living cells • Increased exposure increases the risk • Risk greater inside body than outside • No need for exploratory surgery (non invasive) • Increase in life expectancy potentially • Diagnosis • ALLOW benefits in terms of minimising the risk

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