

Foundation

GCSE

Physics A Gateway

J249/02: Paper 2 (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. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.
- Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in *italics*) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in *italics*) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper is **20(a)**.

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.

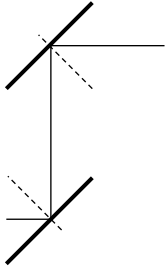
The breakdown of Assessment Objectives for GCSE (9-1) in Physics A:

	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.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question			Answer	Marks	AO element	Guidance
1			D ✓	1	1.2	
2			B ✓	1	1.1	
3			D ✓	1	1.1	
4			D ✓	1	1.1	
5			D ✓	1	2.1	
6			A ✓	1	1.2	
7			C ✓	1	1.1	
8			B ✓	1	1.1	
9			A ✓	1	2.2	
10			B ✓	1	1.1	
11			A ✓	1	2.1	
12			C ✓	1	1.1	
13			C ✓	1	1.2	
14			B ✓	1	2.2	
15			A ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
16	(a)			3	3 × 1.1	Award 2 marks for 2 or 3 correct Award 1 mark for 1 correct
	(b)	(i)	X-rays ✓	1	1.1	
		(ii)	Any two from: It has the highest frequency / energy / shortest wavelength ✓ It is ionising (radiation) ✓ It can cause cancer / damage cells / kill cells ✓	2	2 × 1.1	ALLOW these marks if answer to 16(b)(i) is incorrect. IGNORE harmful IGNORE radiation sickness

Question			Answer	Marks	AO element	Guidance
	(c)		<p>Angle of reflection = angle of incidence at mirror 1 (by eye) ✓</p> <p>Light ray carries on in a straight line to mirror 2 and reflects from the surface of mirror 2 into the eye ✓</p> <p>Correct normal drawn at $\sim 90^\circ$ to the mirror at point ray reflects from mirror 2 (by eye) ✓</p> 	3	3 × 1.2	DO NOT ALLOW if arrow pointing from eye
	(d)	(i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10 (s) award 2 marks</p> <p>Unit conversion: 1 minute = 60 s ✓ Time period = $60 \div 6 = 10$ s ✓</p>	2	1.2 2.2	ALLOW one mark for anything that rounds to 0.17
		(ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 (m / s) award 3 marks</p> <p>wave speed = frequency × wavelength ✓ (wave speed =) 0.2×20 ✓ (wave speed =) 4 (m / s) ✓</p>	3	1.2 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	Use a tape-measure / trundle wheel ✓	1	1.2	IGNORE ruler ALLOW metre rule / stick
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6.0 (m) award 2 marks Mean = $(4.4 + 8.0 + 5.6) \div 3$ ✓ (Mean =) 6.0 (m) ✓	2	2 × 1.2	ALLOW 8(.0) is an anomaly so Mean = $(4.4 + 5.6) \div 2$ ✓ (Mean =) 5(.0) (m) ✓ working must be seen ALLOW 6 (m)
		(iii)	Any one from: They did not use the same force when braking / AW ✓ They did not measure height to the same part of the bike each time ✓ They did not start at the same place on the ramp ✓ They did not apply the brakes at the same place / time ✓	1	3.2a	ALLOW wind may affect braking IGNORE They did not measure distance correctly. IGNORE They used the pedals (instead of freewheeling) IGNORE reaction time / human error
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1600 (J) award 3 marks potential energy = mass × gravitational field strength × height ✓ (potential energy =) $80 \times 10 \times 2.0$ ✓ (potential energy =) 1600 (J) ✓	3	1.2 2 × 2.1	

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	11(m) ✓	1	2.2	
		(ii)	<p>Use of data to show as speed increases, braking distance increases ✓</p> <p>OR</p> <p>(As speed increases,) (braking) distance increases ✓</p> <p>At higher speeds more likely to hit an obstacle (in front) as you travel further before stopping / cause more damage / AW ✓</p>	2	<p>3.1a</p> <p>3.1b</p>	<p>Example at 1m/s, bd = 1m but at 2m/s, bd = 4m.</p> <p>ALLOW stopping for braking ALLOW longer time to stop</p>
		(iii)	<p>Any one from:</p> <p>Repeat for more speeds / heights ✓</p> <p>Make sure constant force when braking / press brakes by same amount each time / AW ✓</p>	1	3.3b	IGNORE repeats experiment / averages results
	(d)		Increases ✓	1	1.1	
	(e)		<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.5 – 3.0 (m / s²) award 3 marks</p> <p>Estimate for time = 2 – 12 seconds ✓</p> <p>Acceleration = 6 ÷ their estimate of time ✓</p> <p>(Acceleration =) 0.5 – 3(.0) m / s² ✓</p>	3	3 × 2.1	

Question			Answer	Marks	AO element	Guidance
18	(a)		Speed of light is (much) higher than speed of sound / AW ✓	1	1.1	
	(b)		Longitudinal ✓ Parallel ✓	2	2 × 1.1	
	(c)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 140 (m) award 4 marks distance travelled = speed × time ✓ (distance travelled =) 330×0.42 ✓ (distance travelled =) 138.6 or 139 ✓ (distance travelled =) 140 (m) (to 2sf) ✓	4	1.2 2.1 2.1 1.2	
	(d)		Idea time measured is incorrect ✓ due to child's reaction time / distracted / child hears a different firework / sound cannot be heard clearly / wind may have an effect ✓ OR Idea speed of sound varies ✓ Air is different temperature / density ✓	2	3.2b 3.2a	DO NOT ACCEPT faulty stopwatch ALLOW different altitudes

Question			Answer	Marks	AO element	Guidance
19	(a)		Any two from: Energy transferred electrically from the supply to the heating element or energy transferred by heating from element to the water. ✓ (So) thermal energy store of the element increases. ✓ (So) thermal energy store of water increases. ✓	2	2 × 2.1	IGNORE conduction and convection (as question refers to energy stores).
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 150 000 (J) award 3 marks Temperature change = $95 - 20 = 75^{\circ}\text{C}$ ✓ Change in thermal energy = $10 \times 4200 \times 75$ ✓ (Change in thermal energy =) 3 150 000 (J) ✓	3	2.2 2 × 2.1	ALLOW ECF from their temperature change.
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8 (A) award 3 marks Current = power ÷ p.d ✓ (Current =) $1840 \div 230$ ✓ (Current =) 8 (A) ✓	3	1.2 2 × 2.1	Rearrangement of the given equation

Question			Answer	Marks	AO element	Guidance
	(c)	(ii)	Any two from: The power would be higher ✓ The water would heat up quicker ✓ (So) more water could be heated (in the same time) ✓	2	3.2a	IGNORE Higher currents are more dangerous IGNORE it would get hotter
	(d)		<u>All</u> three boxes ticked ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
20	(a)	*	<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) Detailed description of the changes using data for both coal and renewables AND a detailed explanation of why the changes occurred in terms of advantages of renewable resources and disadvantages of coal.</p> <p><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) Description of the changes for both coal and renewables AND an explanation of the changes in terms of advantages of renewable resources and disadvantages of coal.</p> <p>OR Detailed description of the changes using data for both coal and renewables with basic explanation for coal and/or renewables.</p> <p><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) Simple relationship from the graph with basic explanation for coal and/or renewables.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p>	6	<p>3 × 3.1a 3 × 2.1</p>	<p>AO3.1a – Analyses information by interpreting the graph</p> <ul style="list-style-type: none"> • Use of coal has (generally) decreased. • Use of renewable has increased. • Coal decreased from 31% in 1990 to 5% in 2017. • Between 1999 and 2012 use of coal increased several times. • Renewables increased from 0.5% in 1990 to 11% in 2017. • Rate of increase of renewables is greater in more recent years. • Use of coal and renewables was the same in 2015-16 at 10%. <p>AO2.1a – Applies knowledge and understanding of renewable and non-renewable energy resources.</p> <ul style="list-style-type: none"> • Population has a greater awareness of environmental issues today. • UK government committed to ‘greener’ energy resources. • Coal is a non-renewable / finite energy resource. • Coal produces greenhouse gases / CO₂. • CO₂ contributes to global warming / climate change. • Coal produces other named pollutants e.g. SO₂ • Named renewable energy resources (solar / wind / biomass / tidal / wave) • More wind turbines / solar panels have been built • Cost of wind turbines / solar panels have reduced over time. • Renewable energy resources produce less greenhouse gases / less pollution / less CO₂. • Renewables energy resources are sustainable / have low fuel costs once set up.

Question			Answer	Marks	AO element	Guidance
			0 marks <i>No response or no response worthy of credit.</i>			

Question			Answer	Marks	AO element	Guidance
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6×10^6 (kWh) award 2 marks Energy transferred = $3 \times 2 \times 10^6$ ✓ (Energy transferred =) 6×10^6 (kWh) ✓	2	2 × 2.1	ALLOW 6 000 000 (kWh)

Question			Answer	Marks	AO element	Guidance
21	(a)		<p>Any three from:</p> <p>Use a force meter/newton meter to measure (pulling) force ✓</p> <p>Measure distance (moved) using a ruler/metre rule/measuring tape ✓</p> <p>Repeat experiment with different masses (on the wooden block) ✓</p> <p>Use work done = force $\times$ distance ✓</p>	3	3 $\times$ 3.3a	<p>ALLOW metre stick / metre tape</p> <p>ALLOW different weights (on the wooden block)</p> <p>ALLOW balance/scales to measure mass (on the wooden block)</p> <p>IGNORE ideas about masses on pulleys</p> <p>IGNORE idea of repeating the same experiment (with same mass)</p>
	(b)	(i)	<p>4 points correctly plotted to within $\frac{1}{2}$ small square ✓✓</p> <p>Thin, straight line of best fit drawn ✓</p>	3	3 $\times$ 2.2	<p>ALLOW 1 mark for 2 points correctly plotted.</p> <p>DO NOT ALLOW points more than half a square in diameter</p> <p>DO NOT ALLOW all points above or below the line</p> <p>IGNORE line before first plot</p> <p>DO NOT ALLOW first plot joined to last plot</p> <p>ALLOW ECF for lobf drawn for candidate's points</p>
		(ii)	Work done increases as mass increases / ORA ✓	1	3.1a	<p>ALLOW linear relationship</p> <p>IGNORE it is proportional</p> <p>IGNORE positive correlation</p>

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	Line with positive gradient drawn below the first line of best fit (for all points) ✓	1	3.2b	IGNORE horizontal line / line starting at origin ALLOW curve / missing label L DO NOT ALLOW if the line cuts the x axis from 0.1 kg or more
		(ii)	Any one from: (The lubricant) reduces friction ✓ reduces transfer to thermal energy (store) ✓	1	2.1	ALLOW less friction / prevents friction / less resistance (to motion) ALLOW heat for thermal energy ALLOW less energy transferred to other stores / less energy dissipated / more efficient IGNORE less work done / less energy (needed) / less force

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	$^{32}_{15}\text{P}$ ✓	1	2.1	Both numbers in the correct order needed for the mark.
		(ii)	Relative charge: (+) 16 ✓ Relative mass: (+) 32 ✓	2	2 × 2.1	ALLOW increases by 1 ALLOW stays the same
	(b)		(the) same (as B) ✓ less (than B) ✓	2	2 × 2.1	
	(c)	(i)	Gamma / beta ✓ As it is the <u>most/more</u> penetrating / can be detected outside the body / ORA for alpha ✓	2	2 × 1.2	Mark independently ALLOW this mark if alpha is chosen ALLOW (gamma/beta) passes through the body/skin (easily) ALLOW very/highly penetrating ALLOW least/less ionising ALLOW alpha and/or beta would be (mostly) absorbed by the body / gamma can leave body IGNORE ideas about effects on the body
		(ii)	(Idea that half-life is) long enough to allow the isotope to circulate around the body / ORA for ideas about half-life of 4 minutes ✓ (Idea that half-life is) short enough for less damage/harm (to patient's cells/body) / patient will not be contaminated/radioactive for a long time / ORA for ideas about half-life of 18 days ✓	2	2 × 3.2a	ALLOW long enough to get results/information / take observations / explore organs / get to the patient from the lab ALLOW (idea that) four minutes is not long enough to take observations / look at patients / do experiments with / for it to work IGNORE it can be used for a long time ALLOW (idea that) 18 days is too harmful / too long for patient to be contaminated/radioactive IGNORE it won't emit too much radiation / it is dangerous

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