

# 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).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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.



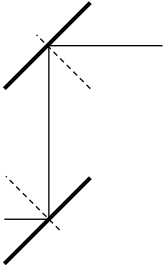
The breakdown of Assessment Objectives for GCSE (9-1) in Physics A:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	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.
<b>AO3.3</b>	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)	<p><b>Any two from:</b></p> <p>It has the highest frequency / energy / shortest wavelength ✓</p> <p>It is ionising (radiation) ✓</p> <p>It can cause cancer / damage cells / kill cells ✓</p>	2	2 × 1.1	<p><b>ALLOW</b> these marks if answer to 16(b)(i) is incorrect.</p> <p><b>IGNORE</b> harmful</p> <p><b>IGNORE</b> radiation sickness</p>

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 ~90° 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><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 10 (s) award 2 marks</b></p> <p>Unit conversion: 1 minute = 60 s ✓                      Time period = 60 ÷ 6 = 10 s ✓</p>	2	1.2 2.2	ALLOW one mark for anything that rounds to 0.17
(ii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 4 (m / s) award 3 marks</b></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	<b>IGNORE</b> ruler <b>ALLOW</b> metre rule / stick
		(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 6.0 (m) award 2 marks</b>  Mean = $(4.4 + 8.0 + 5.6) \div 3$ ✓ (Mean =) 6.0 (m) ✓	2	2 × 1.2	<b>ALLOW</b> 8(.0) is an anomaly so Mean = $(4.4 + 5.6) \div 2$ ✓ (Mean =) 5(.0) (m) ✓ working must be seen  <b>ALLOW</b> 6 (m)
		(iii)	<b>Any one from:</b> 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	<b>ALLOW</b> wind may affect braking  <b>IGNORE</b> They did not measure distance correctly. <b>IGNORE</b> They used the pedals (instead of freewheeling) <b>IGNORE</b> reaction time / human error
	(b)		<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 1600 (J) award 3 marks</b>  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)	Use of data to show as speed increases, braking distance increases ✓ <b>OR</b> (As speed increases,) (braking) distance increases ✓  At higher speeds more likely to hit an obstacle (in front) as you travel further before stopping / cause more damage / AW ✓	2	3.1a  3.1b	<b>Example</b> at 1m/s, bd = 1m but at 2m/s, bd = 4m.  <b>ALLOW</b> stopping for braking <b>ALLOW</b> longer time to stop
	(iii)	<b>Any one from:</b>  Repeat for more speeds / heights ✓  Make sure constant force when braking / press brakes by same amount each time / AW ✓	1	3.3b	<b>IGNORE</b> repeats experiment / averages results
	(d)	Increases ✓	1	1.1	
	(e)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 0.5 – 3.0 (m/s<sup>2</sup>) award 3 marks</b>  Estimate for time = 2 – 12 seconds ✓  Acceleration = 6 ÷ their estimate of time ✓  (Acceleration =) 0.5 – 3(.0) m/s <sup>2</sup> ✓	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)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 140 (m) award 4 marks</b>  distance travelled = speed × time ✓ (distance travelled =) $330 \times 0.42$ ✓ (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	<b>DO NOT ACCEPT</b> faulty stopwatch      <b>ALLOW</b> different altitudes

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



Question		Answer	Marks	AO element	Guidance
	(c) (ii)	<p><b>Any two from:</b></p> <p>The power would be higher ✓</p> <p>The water would heat up quicker ✓</p> <p>(So) more water could be heated (in the same time) ✓</p>	2	3.2a	<p><b>IGNORE</b> Higher currents are more dangerous</p> <p><b>IGNORE</b> it would get hotter</p>
	(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><b>Level 3 (5–6 marks)</b> Detailed description of the changes using data for both coal and renewables <b>AND</b> 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><b>Level 2 (3–4 marks)</b> Description of the changes for both coal and renewables <b>AND</b> an explanation of the changes in terms of advantages of renewable resources and disadvantages of coal.</p> <p><b>OR</b> 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><b>Level 1 (1–2 marks)</b> 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	3 × 3.1a 3 × 2.1	<p><b>AO3.1a – Analyses information by interpreting the graph</b></p> <ul style="list-style-type: none"> <li>• Use of coal has (generally) decreased.</li> <li>• Use of renewable has increased.</li> <li>• Coal decreased from 31% in 1990 to 5% in 2017.</li> <li>• Between 1999 and 2012 use of coal increased several times.</li> <li>• Renewables increased from 0.5% in 1990 to 11% in 2017.</li> <li>• Rate of increase of renewables is greater in more recent years.</li> <li>• Use of coal and renewables was the same in 2015-16 at 10%.</li> </ul> <p><b>AO2.1a – Applies knowledge and understanding of renewable and non-renewable energy resources.</b></p> <ul style="list-style-type: none"> <li>• Population has a greater awareness of environmental issues today.</li> <li>• UK government committed to ‘greener’ energy resources.</li> <li>• Coal is a non-renewable / finite energy resource.</li> <li>• Coal produces greenhouse gases / CO<sub>2</sub>.</li> <li>• CO<sub>2</sub> contributes to global warming / climate change.</li> <li>• Coal produces other named pollutants e.g. SO<sub>2</sub></li> <li>• Named renewable energy resources (solar / wind / biomass / tidal / wave)</li> <li>• More wind turbines / solar panels have been built</li> <li>• Cost of wind turbines / solar panels have reduced over time.</li> <li>• Renewable energy resources produce less greenhouse gases / less pollution / less CO<sub>2</sub>.</li> <li>• Renewables energy resources are sustainable / have low fuel costs once set up.</li> </ul>

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

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

Question		Answer	Marks	AO element	Guidance
21	(a)	<p><b>Any three from:</b></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 × distance ✓</p>	3	3 × 3.3a	<p><b>ALLOW</b> metre stick / metre tape</p> <p><b>ALLOW</b> different weights (on the wooden block)</p> <p><b>ALLOW</b> balance/scales to measure mass (on the wooden block)</p> <p><b>IGNORE</b> ideas about masses on pulleys</p> <p><b>IGNORE</b> idea of repeating the same experiment (with same mass)</p>
	(b)	(i)	3	3 × 2.2	<p><b>ALLOW</b> 1 mark for 2 points correctly plotted.</p> <p><b>DO NOT ALLOW</b> points more than half a square in diameter</p> <p><b>DO NOT ALLOW</b> all points above or below the line</p> <p><b>IGNORE</b> line before first plot</p> <p><b>DO NOT ALLOW</b> first plot joined to last plot</p> <p><b>ALLOW ECF</b> for lobf drawn for candidate's points</p>
		(ii)	1	3.1a	<p><b>ALLOW</b> linear relationship</p> <p><b>IGNORE</b> it is proportional</p> <p><b>IGNORE</b> 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	<b>IGNORE</b> horizontal line / line starting at origin <b>ALLOW</b> curve / missing label L <b>DO NOT ALLOW</b> if the line cuts the x axis from 0.1 kg or more
	(ii)	<b>Any one from:</b> (The lubricant) reduces friction ✓  reduces transfer to thermal energy (store) ✓	1	2.1	<b>ALLOW</b> less friction / prevents friction / less resistance (to motion)  <b>ALLOW</b> heat for thermal energy <b>ALLOW</b> less energy transferred to other stores / less energy dissipated / more efficient <b>IGNORE</b> less work done / less energy (needed) / less force

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

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