

Higher

GCSE

Physics A Gateway

J249/02: Paper 2 (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

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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 the annotation SEEN to confirm that the work has been read.
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 is **17(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 carefully read **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	B	1	1.1	
2	C	1	1.2	
3	A	1	1.2	
4	C	1	1.1	
5	C	1	1.1	
6	D	1	2.1	
7	D	1	2.1	
8	A	1	1.2	
9	C	1	1.1	
10	A	1	2.1	
11	A	1	1.1	
12	D	1	2.1	
13	B	1	1.1	
14	B	1	1.1	
15	D	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)	(ii)	<p>✓✓</p>	2	2 × 1.1	All 4 correct = 2 marks Any 2 or 3 correct = 1 marks
		(ii)	Main sequence star ✓	1	1.1	
	(b)	(i)	Gravity ✓	1	1.1	
		(ii)	Equal to ✓	1	1.1	
	(c)	(i)	B ✓	1	1.1	
		(ii)	D ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
17	(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 extra equipment and what it measures AND a detailed method AND a control variable identified</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) Detailed method AND either control variable identified or some relevant extra equipment chosen OR Basic method outlined AND a control variable identified AND some relevant equipment chosen</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) Basic method outlined AND either a control variable identified or some relevant equipment chosen OR Some relevant equipment chosen AND a control variable</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> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	<p>2 × 1.2 2 × 2.2 2 × 3.3a</p>	<p>AO1.2 – Demonstrates knowledge and understanding of scientific techniques to choose equipment for the experiment</p> <ul style="list-style-type: none"> • measure time with stopwatch • measure the temperature of water with a thermometer • measure the volume of water with a measuring cylinder or the mass of water with a balance • measure thickness of insulation with a ruler <p>AO2.2 – Applies knowledge and understanding of scientific enquiry to develop a valid experiment by controlling variables</p> <ul style="list-style-type: none"> • the starting temperature • the time / end temperature / change in temperature • volume / mass of water • room temperature <p>AO3.3a – Analyses information and ideas to develop the method for the practical</p> <ul style="list-style-type: none"> • measure temperature of water at the start • measure temperature at regular time intervals or at a fixed time • change the thickness of cardboard and repeat experiment • repeat each measurement for each thickness • calculates a mean temperature change • use at least 5 thicknesses of cardboard • safety consideration for hot water

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	(As time increases) temperature decreases / ORA ✓	1	3.1a	ALLOW it cools / gets colder
		(ii)	Values / repeats / results (at each time) are close together / almost the same / similar ✓	1	3.1b	ALLOW the same results
		(iii)	Any two from: The line is curved / not a straight line / not linear ✓ The line does not pass through origin / zero ✓ The line has a negative gradient ✓	2	2 x 3.2a	ALLOW gradient changes ALLOW there is an intercept / non-zero starting temperature ALLOW (as time increases,) temperature decreases / line 'goes down' / negative correlation

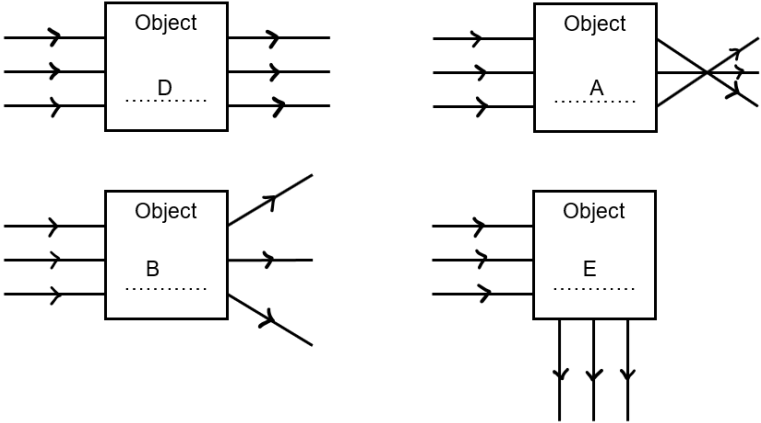
Question			Answer	Marks	AO element	Guidance
18	(a)		Coal ✓ Solar ✓	2	2 x 3.2b	In either order
	(b)		First check the answer on answer line If answer = 24 - 26 (%) award 3 marks Angle is approximately 90° ✓ (% =) $90 / 360$ or $1 / 4$ or 0.25 ✓ (% =) 25 (%) ✓	3	3 x 1.2	ALLOW one mark for $(62 \pm 2) / 360$ (2019 data) ALLOW two marks for 17% or 18% (2019 data)
	(c)		Gas ✓ Wind ✓	2	2 x 2.2	In either order IGNORE direction of change
	(d)		First check the answer on answer line If answer = 7.7 (%) award 3 marks 0.3 ✓ (% change =) $(0.3 \div 3.9) \times 100$ or $((4.2 - 3.9) \div 3.9) \times 100$ or $7.692\dots$ (%) ✓ (% change =) 7.7 (%) (1dp) ✓	3	3 x 2.1	ALLOW one mark for $((4.2-3.9) \div 4.2) \times 100$ ALLOW two marks for 7.1 (%) ALLOW two marks for 7.6 (%) ALLOW this mark for clear evidence of an incorrect answer correctly rounded to one decimal place (not a bald answer to 1 d.p.)

Question			Answer	Marks	AO element	Guidance
	(e)	(i)	<p>Any one from:</p> <p>Public opinion / government committed to renewable / green energy resources ✓</p> <p>Coal is a non-renewable / finite energy resource ✓</p> <p>Reduces pollution / named pollutant e.g., CO₂ / SO₂ ✓</p> <p>Reduces global warming / climate change / greenhouse gases ✓</p>	1	1.1	<p>ALLOW Coal produces pollution / named pollutant CO₂ / SO₂</p> <p>ALLOW Coal contributes to global warming / climate change / greenhouse gases ✓</p>
		(ii)	<p>Any two from:</p> <p>Not enough sun (for photovoltaic cells) ✓</p> <p>Not enough wind (for turbines) ✓</p> <p>To avoid power cuts ✓</p> <p>Increase in demand with reason e.g., it may have been colder on that day ✓</p> <p>Some power stations may have broken down ✓</p>	2	2 × 3.2a	<p>IGNORE costs e.g., coal is cheap</p> <p>IGNORE meeting demand / gap</p> <p>IGNORE there is a high demand for electricity</p>

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	<div> <div>ultra-violet</div> <div>X-ray</div> <div>gamma rays</div> </div> ✓✓	2	2 x 2.1	All three correct = 2 marks One (or two) correct = 1 mark ALLOW UV for ultra-violet
		(ii)	Decreases ✓	1	1.1	
	(b)		First check the answer on answer line If answer = 0.5 (μm) award 2 marks Vertical line drawn on graph (in approximately correct position) ✓ $\lambda = 0.5 \text{ (}\mu\text{m)}$ ✓	2	2 x 3.1a	
	(c)	(i)	Microwaves ✓	1	3.2b	
		(ii)	Big bang (theory) / expanding universe ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
20	(a)		First check the answer on answer line If answer = 96 000 (J) award 2 marks (Potential energy =) $800 \times 10 \times 12$ ✓ (Potential energy =) 96 000 (J) ✓	2	2 × 2.1	
	(b)		First check the answer on answer line If answer = 40 000 (J) award 2 marks (Kinetic energy =) $\frac{1}{2} \times 800 \times 10^2$ ✓ (Kinetic energy =) 40 000 (J) ✓	2	2 × 2.1	
	(c)		Energy is transferred to the thermal energy (store) ✓ And any one from: (Work is done against) friction / drag / resistive forces ✓ Energy is transferred in the surroundings / brakes ✓	2	2 × 2.1	ALLOW heat for thermal energy ALLOW energy transferred to the surroundings by heating scores two marks
	(d)		First check the answer on answer line If answer = 0.4 award 2 marks (efficiency =) $48\,000 \div 120\,000$ ✓ (efficiency =) 0.4 ✓	2	2 × 2.1	ALLOW for one mark 0.4% ALLOW for two marks 40%

Question			Answer	Marks	AO element	Guidance												
21	(a)		Thinking distance bar plotted correctly to within $\pm \frac{1}{2}$ square ✓ Braking distance bar plotted correctly to within $\pm \frac{1}{2}$ square ✓	2	2 × 1.2													
	(b)		Thinking distance in range 17 - 19 m ✓ Braking distance in range 44 - 64 m ✓	2	2 × 3.2a													
	(c)		(Overall) <u>stopping</u> distance ✓	1	1.1													
	(d)		<table><tr><th>Factor</th><th>Thinking distance</th><th>Braking distance</th></tr><tr><td>Drinking alcohol</td><td>increases</td><td>no effect</td></tr><tr><td>Higher speed</td><td>increases</td><td>increases</td></tr><tr><td>Wet road</td><td>no effect</td><td>increases</td></tr></table> ✓✓✓	Factor	Thinking distance	Braking distance	Drinking alcohol	increases	no effect	Higher speed	increases	increases	Wet road	no effect	increases	3	3 × 2.1	1 mark for each correct row
Factor	Thinking distance	Braking distance																
Drinking alcohol	increases	no effect																
Higher speed	increases	increases																
Wet road	no effect	increases																
	(e)	(i)	First check the answer on answer line If answer = 112 000 J award 3 marks (Work done =) 5600 × 20 ✓ (Work done =) 112 000 ✓ J OR N m ✓	3	2.1 2.1 1.1	Unit mark is independent												
		(ii)	Double-decker bus has more mass ✓	1	2.1	ALLOW more kinetic energy / heavier / greater weight / greater load												

Question	Answer	Marks	AO element	Guidance
22 (a)	<p>D ✓ A ✓ B ✓ E ✓</p> 	4	4 × 1.2	
(b)	<p>First check the answer on answer line If answer = 4.6×10^{14} (Hz) award 4 marks</p> <p>Rearrange to give: $(f =) v \div \lambda$ ✓</p> <p>$(f =) 2 \times 10^8 \div (4.33 \times 10^{-7})$ ✓</p> <p>$(f =) 4.62... \times 10^{14}$ (Hz) ✓</p> <p>$(f =) 4.6 \times 10^{14}$ (Hz) (2sf) ✓</p>	4	<p>1.2</p> <p>2.1</p> <p>2.1</p> <p>1.2</p>	<p>ALLOW 1 mark for correct substitution into unarranged equation e.g., $2 \times 10^8 = f \times 4.33 \times 10^{-7}$</p> <p>ALLOW $4.62... \times 10^n$ for 2 marks</p> <p>ALLOW 4.6×10^n for 3 marks ALLOW this mark for clear evidence of an incorrect answer (correctly rounded) to two significant figures (not a bald incorrect answer to 2 s.f.)</p>

	(c)	(i)	(shirt) Black (number) Blue ✓	1	2.1	Both required for 1 mark
		(ii)	(White) number (and shirt) reflects red (light only) / (white) number (and shirt) looks red / (white) number and shirt look the same colour ✓	1	2.1	ALLOW (idea that) both look red / whole shirt looks red / both look the same colour DO NOT ALLOW red is absorbed by shirt/number / both look any incorrect colour IGNORE they blend in IGNORE any other colours absorbed

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	(Idea that half-life is short enough) so water/surroundings don't remain radioactive for too long ✓ (Idea that half-life is long enough) to allow repeat readings / for examination to take place ✓	2	2 × 3.1b	ALLOW so it doesn't contaminate/irradiate/emit radiation/stay unstable for too long IGNORE less damage/harm ALLOW (idea that) it stays in pipe long enough to detect the leak / enough time to be detected / enough time to reach leak IGNORE it lasts for a long time / long enough to be used/useful
		(ii)	(Tracer/radiation/beta/gamma) can be detected above earth/ground ✓	1	1.2	ALLOW beta/gamma can penetrate/pass through/get through the ground/earth IGNORE beta/gamma are very penetrating IGNORE ideas about alpha
		(iii)	(Stable isotope) does not emit (ionising) radiation / ORA ✓	1	3.2b	ALLOW (stable isotope) is not radioactive / does not contaminate/irradiate/decay / ORA IGNORE so it is no longer dangerous / so it becomes safe
	(b)		Any two from: Tracer is added to pipe/water / detector is moved along the surface of the ground ✓ Reading (on the detector) will increase (above the leak) ✓ (Reading on the detector will increase when the detector is) above/around the leak ✓	2	2 × 2.2	ALLOW detector is placed above the ground/pipe ALLOW more radiation is detected (above the leak) ALLOW (more radiation is detected) above/around the leak

	(c)		<p>First check the answer on answer line If answer = 3 (mg) award 2 marks</p> <p>(30 ÷ 15 =) 2 (half-lives) ✓</p> <p>(Mass remaining = $12 \times (0.5)^2 = 3$ (mg) ✓</p>	2		
					2.1	<p>ALLOW any indication of two halvings shown, e.g., of 24 or 15</p>
					2.1	

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