

Foundation

GCSE

Physics A Gateway

J249/03: Paper 3 (Higher 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 **21(b)**.

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:

	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	C	1	1.1	
2	A	1	1.1	
3	A	1	1.2	
4	D	1	1.1	
5	D	1	2.1	
6	B	1	1.1	
7	C	1	1.1	
8	A	1	1.2	
9	D	1	2.1	
10	B	1	1.2	
11	A	1	2.2	
12	C	1	2.1	
13	C	1	2.1	
14	D	1	2.1	
15	D	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)		First check the answer on answer line If answer = 3.5 (m/s) award 3 marks (average) speed = distance travelled ÷ time ✓ 2.1 ÷ 0.6 ✓ 3.5 (m/s) ✓	3	1.2 2.1 2.1	Correct rearrangement IGNORE triangles 2.1 ÷ 0.6 gains 2 marks
	(b)	(i)	Upwards force arrow: <u>air</u> resistance / drag ✓ Downwards force arrow: weight / (force due to) gravity / gravitational force ✓	2	2 x 1.2	ALLOW friction of air / wind resistance DO NOT ALLOW upthrust ALLOW pull / attraction for force IGNORE Gravitational field strength
		(ii)	(There is a) net / resultant / overall / unbalanced force downwards ✓ And any one from: Ball accelerates / speeds up / gets faster ✓ Ball speeds up so air resistance increases ✓ OR Acceleration of ball reduces / velocity of ball increases <u>until</u> forces are balanced ✓✓	2	3.2b 3.2a	ALLOW weight (force) is larger than the air resistance (force) ALLOW increase kinetic energy (store)
	(c)		First check the answer on answer line If answer = 90 000 (N) award 3 marks F = ma / force = mass x acceleration ✓ 30 000 x 3 ✓ 90 000 (N) ✓	3	1.2 2.1 2.1	ALLOW 90 kN

Question			Answer	Marks	AO element	Guidance
17	(a)		One correct calculation is completed ✓ A second correct calculation is completed ✓ Conclusion from at least two calculations, e.g., $P \times V$ for two (or more) calculations gives the same / equal value (so the formula is true) ✓	3	2.1 2.1 3.2b	E.g., $300 \times 250 = 75\,000$ / $500 \times 150 = 75\,000$ / $625 \times 120 = 75\,000$ / $1250 \times 60 = 75\,000$ ALLOW 75 000 on at least two rows of the table IGNORE pressure $\times$ volume = constant (from question)
	(b)	(i)	Correct point plotted at (500, 150) ✓	1	1.1	Point plotted with $\frac{1}{2}$ small square Diameter of point less than $\frac{1}{2}$ small square
		(ii)	Best fit line drawn as a single unbroken curve (by eye) ✓	1	2.2	DO NOT ALLOW straight line IGNORE line before 300 kPa and after 1250 kPa
		(iii)	Value read from graph in the range 80 to 90 (cm^3) ✓	1	3.1b	ALLOW ECF from candidate's graph if outside range – volume value read to $\frac{1}{2}$ small square.
	(c)		It decreases / reduces / goes down (with increased height) / ORA ✓ There is less atmosphere / air above (pushing down) ✓	2	2 x 1.1	 ALLOW fewer particles above it IGNORE gravity / density

Question			Answer	Marks	AO element	Guidance
18	(a)	(i)	Incorrect <u>and</u> Force is not proportional to extension ✓	1	1.2	ALLOW line is not straight (through the origin) / not linear / gradient not constant / is a curve IGNORE faster / slower etc.
		(ii)	Incorrect <u>and</u> It returns to its original length / shape (when force is removed) ✓	1	1.2	ALLOW it returns to (an extension of) zero
		(iii)	Incorrect <u>and</u> Line is not straight (through the origin) / line does not have constant gradient / line is a curve ✓	1	1.2	ALLOW force is not proportional to extension IGNORE not linear IGNORE faster / slower etc.
	(b)		First check the answer on answer line If answer = 0.56 (J) award 2 marks ($W = \frac{1}{2} kx^2$) $W = \frac{1}{2} \times 28 \times 0.20^2$ ✓ $W = 0.56$ (J) ✓	2	2.1 2.1	IGNORE $28 \times 0.20 = 5.6$ and 1.12
	(c)		Correct resultant line drawn (connecting 0,0 and 6,4) ✓ Length of resultant line = 7.2 (cm) ✓ But Resultant force = 3.6 (N) ✓✓	3	3 x 1.2	Independent mark ALLOW ECF for resultant drawn from (0,4) to (6,0) ALLOW 7.0 – 7.4 (cm) IGNORE ‘–’ sign ALLOW 3.5 – 3.7 (N) ALLOW ($\sqrt{2^2 + 3^2} =$) 3.6 for two marks

Question			Answer	Marks	AO element	Guidance																																	
19	(a)		(Idea that) the cells are facing each other / the cells cancel each other out / a (left) cell is connected the wrong way around ✓ Arrange the cells to face in the same direction / turn one / left cell around ✓ <u>Voltmeter</u> is in the incorrect place / not across the diode ✓ Place voltmeter in parallel / across the diode (instead) ✓	4	4 x 3.3b	ALLOW answers in either order but correction must match the mistake DO NOT ALLOW cells incorrectly set up unless qualified ALLOW remove the (left) cell IGNORE diode in wrong position ALLOW swap diode and variable resistor																																	
	(b)	(i)	0.6 V ✓	1	2.2																																		
		(ii)	For gradient calculated First check the answer on answer line If answer = 5(.0) (Ω) award 4 marks Sensible non-zero value from graph ✓ Gradient = 0.2 ✓ Resistance = 1 ÷ gradient / 1 ÷ 0.2 ✓ Resistance = 5(.0) (Ω) ✓ Or For direct R = V / I method Sensible non-zero values from graph ✓ Resistance calculation, e.g. 1.1 ÷ 0.1 ✓✓ Value of resistance, e.g. 11 (Ω) ✓	4	1.2 2.1 2.1 2.1	Sensible values from graph <table><tr><th>V / V</th><th>I / A</th><th>R / Ω</th></tr><tr><td>0.65</td><td>0.01</td><td>65</td></tr><tr><td>0.70</td><td>0.02</td><td>35</td></tr><tr><td>0.75</td><td>0.03</td><td>25</td></tr><tr><td>0.80</td><td>0.04</td><td>20</td></tr><tr><td>0.85</td><td>0.05</td><td>17</td></tr><tr><td>0.90</td><td>0.06</td><td>15</td></tr><tr><td>0.95</td><td>0.07</td><td>13.6</td></tr><tr><td>1.00</td><td>0.08</td><td>12.5</td></tr><tr><td>1.05</td><td>0.09</td><td>11.6</td></tr><tr><td>1.10</td><td>0.10</td><td>11</td></tr></table> No ECF from incorrect read-off error	V / V	I / A	R / Ω	0.65	0.01	65	0.70	0.02	35	0.75	0.03	25	0.80	0.04	20	0.85	0.05	17	0.90	0.06	15	0.95	0.07	13.6	1.00	0.08	12.5	1.05	0.09	11.6	1.10	0.10	11
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0.65	0.01	65																																					
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0.75	0.03	25																																					
0.80	0.04	20																																					
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1.00	0.08	12.5																																					
1.05	0.09	11.6																																					
1.10	0.10	11																																					

Question			Answer	Marks	AO element	Guidance
20	(a)		<u>Similarities</u> Any two from: Both have alternating / changing current / p.d. / voltage ✓ Both use coil / magnets / magnetic field ✓ Both have (moving) diaphragms ✓ The frequency of the sound equals the frequency of the current ✓ <u>Differences</u> A microphone converts sound (waves) into current / p.d. / electrical signal ✓ A speaker converts current / p.d. / electrical signal into sound (waves) ✓	4	4 x 1.1	IGNORE reference to energy (as it is not relevant to the operation of the transducers) ALLOW a.c. for alternating current ALLOW cone for diaphragm ALLOW in a microphone the cone / diaphragm / magnet moves to produce a current ALLOW in a speaker a current makes a cone / diaphragm / magnet move
	(b)		The (current in the wire) produces a magnetic field ✓ The magnetic field of the magnet and the magnetic field of the wire interact (to exert a force on each other) ✓ The wire experiences a force / moves <u>downwards</u> ✓	3	2.2 2.2 2.2 3.2a	
	(c)		First check the answer on answer line If answer = 1.1 (N) award 3 marks (F = BIL) F = 0.30 x 5.0 x 0.75 ✓ F = 1.125 (N) ✓ F = 1.1 (N) 2 SF ✓	3	2.1 2.1 1.2	

Question			Answer	Marks	AO element	Guidance
21	(a)		To increase the magnetic effect / magnetic field strength / magnetic flux density✓	1	1.2	IGNORE iron is a magnetic material

	(b)	* 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) Detailed description of the trend using data from the table and detailed suggestions on how to ensure accurate and valid results. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Clear description of the trend and some simple suggestions to ensure accurate or valid results. OR Clear suggestions to ensure accuracy and a simple description of the trend. OR Detailed description of the trend shown or detailed suggestions on how to ensure accurate and valid results. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Basic description of the trend indicated. OR Some simple suggestions to ensure accurate or valid results. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i>	6	2 x 3.3a 2 x 3.3b 2 x 3.1a	AO3.1a Analyses the results to interpret the trend. For example: - as current increases the number of paperclips picked up / strength of magnetic field increases - uses data / calculations to demonstrate trend - at 1A 5 paperclips are picked up, at 2A (double) 11 paperclips are picked up (2.2x) - differences between each successive increase calculated e.g. 1A to 2A = 6 - ratio number of paper clips to current calculated - appropriate conclusion - as current doubles the number of paperclips picked up (approximately) doubles - the relationship is (not) linear with reason AO3.3a and AO3.3b Analyses the information to develop/improve experimental procedures. For example: - use same size / mass / type of paperclips - repeat readings to take a mean / discard anomalies - measure current to more decimal places / better accuracy / nearest 0.1A / nearest 0.01A - check ammeter for zero error - use the same nail throughout - use the same number of turns - use the same length of solenoid / fix solenoid to core - use a wider range of currents - allow the coil to cool between readings - hold /fix the coil the same distance from the paperclips on each attempt
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			0 marks <i>No response or no response worthy of credit.</i>			
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Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	Any three from: The <u>metal grid</u> gives the (smoke) particles a charge / gains electrons ✓ The (smoke) particles gain a <u>negative</u> charge ✓ The (smoke) particles are repelled by the metal grid ✓ The (smoke) particles are attracted by / stick to the metal collectors ✓ Opposite charges attract / like charges repel ✓	3	3 x 1.2	The <u>metal grid</u> gives the (smoke) particles a negative charge scores the first two marking points
		(ii)	Any one from: It stops / reduces the small particles / smoke being released into the atmosphere / environment ✓ It stops / reduces people having to breathe the small particles / smoke ✓ It stops / reduces smog / pollution ✓	1	2.2	IGNORE all references to CO ₂ / SO ₂ / greenhouse gases / acid rain
	(b)		High voltages can cause electric shocks / electrocution ✓	1	1.1	IGNORE unqualified it is dangerous IGNORE heating ALLOW description of electrocution in terms of damage to nervous system or heart
	(c)		First check the answer on answer line If answer = 3 (A) award 3 marks $I = Q \div t$ ✓ $I = 360 \div 120$ ✓ $I = 3$ (A) ✓	3	1.2 2.1 2.1	ALLOW 180 (A) 2 marks (no unit conversion). Rearrangement of equation ALLOW ECF for incorrect time conversion if clearly shown.

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	First check the answer on answer line If answer = 28 500 (J) award 2 marks ($E = mc\theta$) $E = 0.50 \times 1900 \times 30$ ✓ $E = 28\,500$ (J) ✓	2	2.1 2.1	ALLOW 29 000 J (rounded to 2 significant figures) ALLOW 28.5 kJ
		(ii)	First check the answer on answer line If answer = 95 (W) award 3 marks $P = E \div t$ ✓ $P = 28\,500 \div (5 \times 60)$ ✓ $P = 95$ (W) ✓	3	1.2 2.1 2.1	ALLOW 23(a)(i) divided by 5 for 2 marks ALLOW 23(a)(i) divided by 300 for 3 marks ALLOW ECF from 23(a)(i) ALLOW 5700 (W) for 2 marks (no unit conversion)
		(iii)	Containers of vaccines / other contents of the freezer need to be cooled ✓ Energy / heat dissipated / transferred to surroundings / environment or energy heat dissipated in motor / compressor ✓	2	2 x 3.2a	IGNORE not 100% efficient
	(b)	(i)	Any two from: Energy is needed to change the state of a material ✓ Energy is needed to break / weaken the bonds (between molecules / particles) or overcome attractive forces (between solid (vaccine) molecules) ✓ Some heat transfer with the surroundings / container ✓	2	2 x 1.2	ALLOW ideas about energy needed to increase separation of molecules

		(ii) First check the answer on answer line If answer = 4000 (doses) award 6 marks $m = E \div L$ ✓ $m = 6800 \div 340000$ ✓ $m = 0.02 \text{ kg}$ ✓ $0.02 \text{ kg} = 20\,000 \text{ mg}$ ✓ (number of doses =) $0.02 \div 5 \times 10^{-6}$ OR $20\,000 \div 5$ ✓ (number of doses =) 4000 ✓ Or $5 \text{ mg} = 5 \times 10^{-6} \text{ kg}$ ✓ energy of one dose $5 \text{ (mg)} \times 340000$ ✓✓ energy of one does = 1.7 J ✓ (number of doses =) $6800 \div 1.7$ ✓ (number of doses =) 4000 ✓	6	1.2 2.1 2.1 1.2 2.1 3.1b	Rearrangement of the equation ALLOW $0.02 \div 5 \times 10^n$ (missing or incorrect conversion from mg to kg) for 4 marks ALLOW 4×10^n doses for 5 marks ALLOW $5 \times 10^n \times 340000$ for 2 marks ALLOW 1.7×10^n (power of ten error) for 3 marks ALLOW 4×10^n doses for 5 marks
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