Foundation

GCSE

Physics A Gateway

J249/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed-out response is not marked and gains no marks

   b. 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
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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 × 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 x 250 = 75 000 / 500 x 150 = 75 000 / 625 x 120 = 75 000 / 1250 x 60 = 75 000 **ALLOW** 75 000 on at least two rows of the table **IGNORE** pressure × volume = constant (from question)
	(b)	(i)	Correct point plotted at (500, 150) ✓	1	1.1	Point plotted with ½ small square Diameter of point less than ½ 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 ½ 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 and 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 and It returns to its original length / shape (when force is removed) ✓	1	1.2	**ALLOW** it returns to (an extension of) zero
		(iii)	Incorrect and 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** ($W = ½ kx^2$) $W = ½ \times 28 \times 0.20^2$ ✓ 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** $\left(\sqrt{2^2 + 3^2} =\right) 3.6$ for two marks

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>19</td><td>(a)</td><td></td><td>(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) ✓</td><td>4</td><td>4 x 3.3b</td><td>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</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>0.6 V ✓</td><td>1</td><td>2.2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>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) ✓</td><td>4</td><td>1.2
2.1
2.1
2.1</td><td>Sensible values from graph

<table><tr><td>V / V</td><td>I / A</td><td>R / Ω</td></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</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
20	(a)		Similarities **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 ✓ Differences 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 downwards ✓	**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. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **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. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Basic description of the trend indicated. **OR** Some simple suggestions to ensure accurate or valid results. *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.*	**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

			0 marks *No response or no response worthy of credit.*			

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 ÷ t ✓ I = 360 ÷ 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= mcθ) E = 0.50 x 1900 x 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 ÷ t ✓ P = 28 500 ÷ (5 × 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**	**6**		
			m = E ÷ L ✓		**1.2**	Rearrangement of the equation
			m = 6800 ÷ 340000 ✓		**2.1**	
			m = 0.02 kg ✓		**2.1**	
			0.02 kg = 20 000 mg✓		**1.2**	
			(number of doses =) 0.02 ÷ $5x10^{-6}$ OR 20 000 ÷ 5 ✓		**2.1**	**ALLOW** 0.02 ÷ 5 $\times 10^{n}$ (missing or incorrect conversion from mg to kg) for 4 marks
			(number of doses =) 4000 ✓		**3.1b**	**ALLOW** 4 x 10^{n} doses for 5 marks
			Or			
			5 mg = 5 $\times 10^{-6}$ kg ✓			
			energy of one dose 5 (mg) × 340000 ✓✓			**ALLOW** 5 $\times 10^{n}$ × 340000 for 2 marks
			energy of one does = 1.7 J ✓			**ALLOW** 1.7 $\times 10^{n}$ (power of ten error) for 3 marks
			(number of doses =) 6800 ÷ 1.7 ✓			
			(number of doses =) 4000 ✓			**ALLOW** 4 x 10^{n} doses for 5 marks

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