GCE

Physics A

H556/02: Exploring physics

A Level

Mark Scheme for June 2025

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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 40% 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 or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed-out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed-out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple-choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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 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 is not 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 e-mail.

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:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. **Annotations**

Annotation		Meaning
✓	Correct response	Used to indicate the point at which a mark has been awarded (**one tick per mark awarded**).
✗	Incorrect response	Used to indicate an incorrect answer or a point where a mark is lost.
AE	Arithmetic error	Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
BOD	Benefit of doubt given	Used to indicate a mark awarded where the candidate provides an answer that is not totally satisfactory, but the examiner feels that sufficient work has been done.
BP	Blank page	Use BP on additional page(s) to show that there is no additional work provided by the candidates.
CON	Contradiction	No mark can be awarded if the candidate contradicts himself or herself in the same response.
ECF	Error carried forward	Used in numerical answers only, unless specified otherwise in the mark scheme. Answers to later sections of numerical questions may be awarded up to full credit provided they are consistent with earlier incorrect answers. Within a question, ECF can be given for AE, TE and POT errors but not for XP.
L1	Level 1	L1 is used to show 2 marks awarded and L1^ is used to show 1 mark awarded.
L2	Level 2	L2 is used to show 4 marks awarded and L2^ is used to show 3 marks awarded.
L3	Level 3	L3 is used to show 6 marks awarded and L3^ is used to show 5 marks awarded.
POT	Power of 10 error	This is usually linked to conversion of SI prefixes. Do not allow the mark where the error occurs. Then follow through the working/calculation giving ECF for subsequent marks if there are no further errors.

Annotation		Meaning
SEEN	Seen	To indicate working/text has been seen by the examiner.
SF	Error in number of significant figures	Where more SFs are given than is justified by the question, do not penalise. Fewer significant figures than necessary will be considered within the mark scheme. **Penalised only once in the paper.**
TE	Transcription error	This error is when there is incorrect transcription of the correct data from the question, graphical read-off, formulae booklet or a previous answer. Do not allow the relevant mark and then follow through the working giving ECF for subsequent marks.
XP	Wrong physics or equation	Used in numerical answers only, unless otherwise specified in the mark scheme. Use of an incorrect equation is wrong physics even if it happens to lead to the correct answer.
^	Omission	Used to indicate where more is needed for a mark to be awarded (what is written is not wrong but not enough).

Annotation	Meaning
/	Alternative and acceptable answers for the same marking point
✓	Separates marking points
Not	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

12. **Subject Specific Marking Instructions**

CATEGORISATION OF MARKS

The marking schemes categorise marks on the MACB scheme.

M marks These are method marks upon which **A**-marks (accuracy marks) later depend. For an **M**-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular **M**-mark, then none of the dependent **A**-marks can be scored.

A marks These are accuracy or answer marks, which either depend on an **M**-mark, or allow a **C**-mark to be scored.

C marks These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a **C**-mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C**-mark is given.

B marks These are awarded as independent marks, which do not depend on other marks. For a **B**-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

SIGNIFICANT FIGURES

If the data given in a question is to 2 sf, then allow an answer to 2 or more significant figures.
If an answer is given to fewer than 2 sf, then penalise once only in the entire paper.
Any exception to this rule will be mentioned in the Guidance.

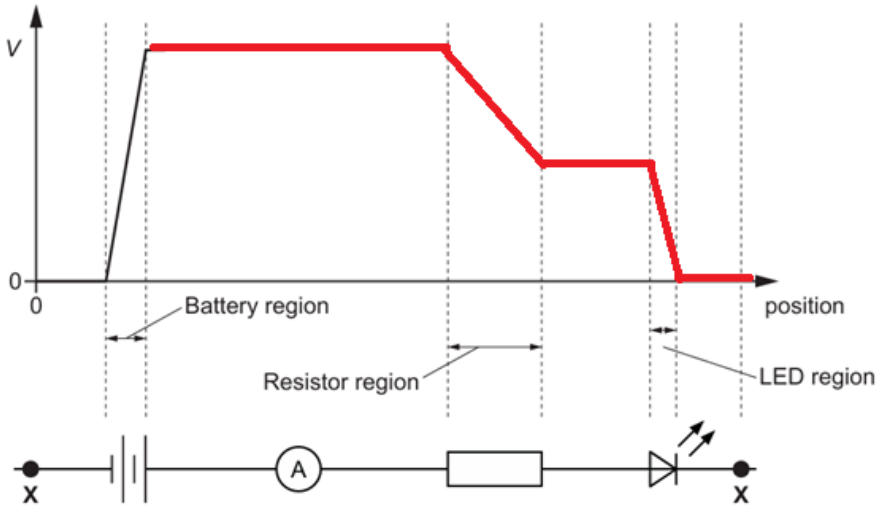
SECTION A

Question	Answer	Marks	Guidance
1	D	1	
2	C	1	
3	D	1	
4	C	1	
5	C	1	
6	A	1	
7	B	1	
8	B	1	
9	C	1	
10	A	1	
11	B	1	
12	C	1	
13	C	1	
14	B	1	
15	B	1	
	Total	15	

SECTION B

General rule: For substitution into an equation, allow any subject - unless stated otherwise in the guidance

Question		Answer	Mark	Guidance
16	**(a)**	Potential divider / Series (circuit)	B1	**IGNORE** potentiometer
16	**(b)**	An arrow pointing in the correct direction (clockwise)	B1	**ALLOW** any arrow indicating correct direction All arrows drawn must be in the correct direction
16	**(c)**	(Ammeter reading) decreases (Voltmeter reading) increases	B1 B1	
16	**(d)**	Number density is high(est) in metals / low(est) in insulators Number density in semiconductors is higher than in insulators and lower than metals	B1 B1	**ALLOW** for use of *n* for number density in both marking points **ALLOW** answers in terms of charge carriers **ALLOW** any numbers as method of comparison in both marking points 2nd marking point is for idea that semiconductors lie in the correct position between metals and insulators and will score both B marks.

Question		Answer	Mark	Guidance
16	(e)	Continuous line, not rising at any point and at least one decrease	B1	
		Non-zero horizontal line across ammeter AND lower non-zero horizontal line from RHS of resistor and to LHS of LED ALLOW very small decrease of voltage across either/both	B1	
		Any decrease shown across the resistor and any decrease shown across LED	B1	
		Zero at (and beyond) RHS of LED	B1	

Question		Answer	Guidance
17		**Level 3 (5–6 marks)** Clear description of both models with experimental evidence for both clearly described There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.	**Indicative points may include:** **Description** **Particles as waves:** Shows wave properties such as interference, diffraction, 'standing waves' (e.g. in atoms) (de Broglie) wavelength = h/p with some discussion Not localised in space like a particle **Waves as particles:** Light consists of photons Photon as quantum of electromagnetic energy, energy = hf Only whole quanta emitted, not continuous energy **Evidence / Justification** **Particles as waves:** Evidence: electron diffraction The fact the evidence can only be explained using the concept of a wave or is not possible in the particle model e.g. • Passed through (e.g.) graphite • Where atomic separation is similar to wavelength • Changing accelerating voltage changes the wavelength and hence the interference pattern • Rings occur due to constructive and destructive interference • Pattern still observed if intensity is very low => even few / single electron shows diffraction pattern => 'one electron' behaves like a wave
		Level 2 (3–4 marks) Clear description of both models **OR** experimental evidence for both models **OR** clear description of one model and experimental evidence on one model **OR** some description of both models and some experimental evidence of both models There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.	
		Level 1 (1–2 marks) Limited description of one model **OR** limited experimental evidence for one model There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.	
		0 marks No response or no response worthy of credit.	

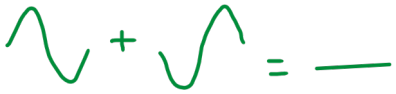
Question		Answer	Guidance
			Waves as particles: Evidence: photoelectric effect / LED threshold voltage / emission absorption spectra / discharge of electroscope The fact the evidence can only be explained using particle concept or is not possible under the wave model e.g. • zero (photoelectric) emission below threshold frequency • zero light of LED below threshold pd • gold foil falls when incident light is above a particular frequency • discrete frequencies of emission due to discrete energy levels • increasing intensity below threshold has no effect => not a continuous energy transfer that we would see with waves

Question		Answer	Mark	Guidance
18	(a)	Heater / cathode / filament	B1	**ALLOW** filament lamp **IGNORE** Thermionic
18	(b)	Cooling / preventing melting (of anode)	B1	**NOT** just 'so the same spot isn't hit all the time'
18	(c)	Electrons (in anode) are removed from (inner) energy level (by collision) (Outer) electron (in anode) falls to lower energy level (emitting characteristic X-ray photon)	B1 B1	Alternative answer: Electrons decelerate on collision with anode (X-rays / photons are produced) because of change in <u>kinetic</u> energy (of electrons)
18	(d)	Photon energy, $(E) = 90 \times 10^3 \times 1.6 \times 10^{-19}$ ($= 1.44 \times 10^{-14}$ J) $\lambda = hc/E = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1.44 \times 10^{-14}}$ $= 1.4 \times 10^{-11}$ (m)	C1 C1 A1	**ALLOW** calculation of conversion of 150 keV (2.4×10^{-14}) or 60 keV (9.6×10^{-15}) for this mark only No conversion to J or conversion using wrong physics (e.g. division by 1.6×10^{-19}) to J is XP Use of $\lambda = h/p$ and $E = mc^2$ is XP Correct to at least 2 significant figures

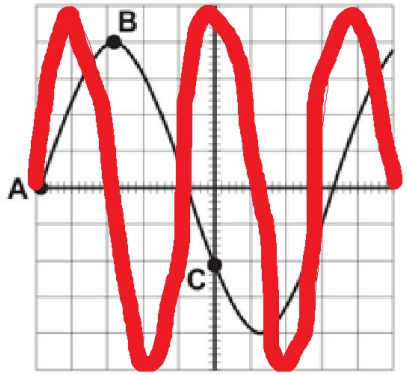
Question		Answer	Mark	Guidance
18	(e)	($I = I_0 e^{-\mu x}$ to give) $0.3 = e^{-(\mu x 4.6)}$	C1	**ALLOW** $3.3 = e^{(\mu x 4.6)}$ Expect to see both 0.3 and 4.6 correctly substituted into equation
		μ (= - ln (0.3) / 4.6) = 0.26 (cm^{-1})	A1	Correct to at least 2 significant figures (0.262 cm^{-1}) Negative final answer (- 0.26) loses second mark

Question		Answer	Mark	Guidance
19	(a)	Hadrons experience the strong force / hadrons are not fundamental particles / hadrons are made of quarks Leptons do not experience strong force / leptons are fundamental / leptons are not made of quarks	B1 B1	**IGNORE** references to mass **IGNORE** number of quarks
19	(b)	Positron and (electron) neutrino	B1	Both required for the mark **ALLOW** anti-electron / beta-plus for positron **IGNORE** symbols
19	(c)	Decay constant = ln 2 / 1220 = (5.7×10^{-4} s^{-1}) $A=800 \times e^{-(5.7 \times 10^{-4} \times 300)}$ A = (800 × 0.84333) = 670 (Bq)	C1 C1 A1	Decay constant = ln2/20.3 = (0.034 min^{-1}) **ALLOW** $A = 800 \times e^{(-0.034 \times 300)}$ Correct to at least 2 significant figures (675 Bq) Value using t in minutes with decay constant in s^{-1} gives 798 (Bq) is MAX 2
19	(d)	Positron emission tomography / PET (scan) Two <u>gamma</u> rays / <u>gamma</u> photons produced (Gamma rays) travel in opposite directions / 180° Arrival time(s) (at detector) used to locate position	B1 B1 B1 B1	 **IGNORE** (gamma) waves and (gamma) radiation **ALLOW** γ for gamma

Question		Answer	Mark	Guidance

Question		Answer	Mark	Guidance
20	**(a)**	Two waveforms in antiphase	B1	**ALLOW** diagram of waves superimposed **ALLOW** waveforms of different amplitudes
		Clearly indicated resultant shown as no disturbance e.g. 	B1	**ALLOW** smaller amplitude resultant wave if two initial waves have different amplitudes For both marks: • Description allowed to support the diagram in both marks • Each initial waveform must have at least one complete cycle
20	**(b) (i)**			**ALLOW** use of tanθ and sinθ interchangeably throughout
		(First bright fringe when) d sinθ = λ OR Path difference is λ	B1	**ALLOW** d sinθ = n λ where n = 1
		Use of tan θ = x/D leading to x/D = λ/d	B1	

Question		Answer	Mark	Guidance
		giving $x \approx D\lambda/d$ $\sin\theta \approx \theta$ OR $\theta \approx \tan\theta$ OR $\sin\theta \approx \tan\theta$	 B1	 Approximation should be given on answer line or clearly identified as such, with use of ≈
20	(b) (ii) (1)	The wavelength decreases So, the spacing / x decreases	M1 A1	**ALLOW** reverse argument **ALLOW** use of λ for wavelength **IGNORE** frequency comments **IGNORE** fringes get smaller
20	(b) (ii) (2)	Fringes disappear Because the light from the source is not <u>coherent</u>	B1 B1	**ALLOW** there is no interference pattern seen
20	(c)	Polarisation is when oscillations are (only) in one direction which is perpendicular to direction of propagation / energy transfer / travel Sound waves are longitudinal In longitudinal/sound waves, the oscillation is parallel to the direction of propagation / energy transfer / travel	B1 B1 B1	**ALLOW** vibrates for oscillates

Question		Answer	Mark	Guidance
21	(a)	B	A1	
21	(b)			At least one complete cycle needs to be drawn for any credit
		Amplitude drawn is larger	B1	Consider all cycles drawn. All peaks must be greater than amplitude of given wave and consistent within ½ square of each other
		Time period drawn is smaller	B1	For T, only mark **first** complete cycle – do not insist on symmetry but such that the end of the first cycle is less than or equal to 8 squares e.g. 

	Question	Answer	Mark	Guidance
21	(c) (i)	$\Phi = BA\cos\theta = 25 \times 10^{-3} \times (8.0 \times 10^{-2} \times 4.0 \times 10^{-2})$ x cos 45 (= 5.66×10^{-5} Wb) Change in flux linkage = $N\Phi = 120 \times 5.66 \times 10^{-5}$ = 6.8×10^{-3} (Wb)	C1 A1	**ALLOW** sinθ for cosθ Only apply POT error in coil dimensions once Calculation of area of circle using one of the given coil dimensions is XP Correct to at least 2 significant figures (6.79×10^{-3}) **IGNORE** sign
21	(c) (ii)	Induced emf ($E = -\Delta\Phi / \Delta t$) = (-) 0.0068 / 0.13 ε = (-) 0.052 (V)	C1 A1	**ALLOW** ECF for flux linkage above but answer to (c)(i) x 120 ÷ 0.13 scores zero marks for this question Correct to at least 2 significant figures **IGNORE** sign
21	(d)	Total power requirement = 580+40+100 = 720 W Power required from mains = 720 - 400 = 320 (W) Mains current drawn = (P / V) = 320 / 230 = 1.4 (A)	C1 A1	**ALLOW** other methods e.g. total current required = (40 + 100 + 580) / 230 = 3.13 (A) Current supplied by mains = current required -current from turbine = 3.13 – (400/230) = 1.4 (A) Correct to at least 2 significant figures

Question		Answer	Mark	Guidance
21	**(e)**	kWh or kilowatt-hour	B1	**IGNORE** case of letters

Question		Answer	Mark	Guidance
22	(a)	Straight line through origin	A1	Judge line and origin by eye
22	(b)	Calculate the area underneath the line (As energy stored =) ½ QV OR Area between the origin and the charged voltage / maximum charge	M1 A1	**ALLOW** drawn on graph if area is clear **ALLOW** area up to end of their line
22	(c) (i)	$Q = I \times t = 2.6 \times 10^{-6} \times 1.8 = (4.68 \times 10^{-6}$ C) $C = Q / V = 4.68 \times 10^{-6} / 800 = (5.85 \times 10^{-9}$ F) $C = \varepsilon A / d = \varepsilon_0 \varepsilon_r A / d$ giving $d = (8.85\text{x}10^{-12} \times 2.3 \text{ x } 30 \times 10^{-2} \times 50 \times 10^{-2}) / 5.9 \times 10^{-9}$ = 0.52 (mm)	C1 C1 A1	 Evaluation of *C* implies first two marks Correct to at least 2 significant figures (0.522mm)
22	(c) (ii)	A modification to the apparatus/method to allow a relevant value to be measured to a greater resolution / to be more accurate	B1	e.g. ruler with greater resolution for length measurements (digital) voltmeter/ammeter with greater resolution Include a resistor to increase the time for charging Datalogger / oscilloscope to measure time / voltage

Question		Answer	Mark	Guidance
		Repeat with change to: sheets / voltage / area And average (or plot a graph) to reduce uncertainty	B1 B1	**ALLOW** random error for uncertainty **IGNORE** human error
22	**(d)**	**Level 3 (5–6 marks)** Clear description of both how the values in each column are calculated, and how calculation can confirm that the spreadsheet models correctly. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.		**Indicative points may include:** Expect to see in one part of the description the use of the formula $\Delta Q/\Delta t = - Q/CR$ Calculation of time constant gives $CR = 22 \times 10^{-6} \times 470 \times 10^{3} = 10.34$ s **Column calculation** Column A: Times determined by the Δt value Increments of Δt Formula: A3 = A2 + Δt etc Column B: Charge decreases, starting with the Q_0 value The decrease is dependent on the previous value Formula: B10 = B9 + C9 etc Or by calculation from $Q = Q_0\exp(-t/CR)$ Column C: Represents change in charge in each time interval Amount of decrease of charge decreases as time increases
		Level 2 (3–4 marks) Clear description of how the values in each column are calculated **OR** clear description of how calculation can confirm that the spreadsheet models correctly **OR** some description of both how the values in each column are calculated and some description of how calculation can confirm that the spreadsheet models correctly		

Question		Answer	Mark	Guidance
		There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.		Formula: C2 = B3 – B2 etc Formula: C2 = (B2*0.5) / (CR) etc $\Delta Q/\Delta t = - \Delta t \times Q/CR$ **Calculation to confirm correct modelling** Use of $\Delta Q/\Delta t = - Q/CR$ to demonstrate correct values in columns B and C. (e.g. for row 10, $Q = Q_0 \exp(-t/CR) = 200 \times 10^{-6} \exp(-4.0 / (22 \times 10^{-6} \times 470 \times 10^{3}) = 136$ mC and comparison with table value Determination of time constant from graph (e.g. 37% of 200 = 74mC, time at 74mC is approximately 10s, with comparison to calculated value (10.34 s)
		Level 1 (1–2 marks) Limited description of how the values in each column are calculated **OR** limited description of how calculation can confirm that the spreadsheet models correctly There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.		
		0 marks No response or no response worthy of credit.		

Question		Answer	Mark	Guidance
23	(a)	Starting point: Ratio of resistance and voltages: R/V = (33+R) / 3 OR V/R = (3-V) / 33 OR (33+R) / 3 = 33 / (3-V) OR (Use of potential divider equation) V = 3 (R / (R+33)) Algebra leading to: R = 33V / (3.0 - V)	M1 A1	**ALLOW** all the starting point equations in any subject **ALLOW** as starting point, current methods I = 3 ÷ (33+R) OR I = (3 – V) / 33 OR Kirchhoff's law method Expect to see final expression

	Question	Answer	Mark	Guidance
23	(b) (i)	4.93 and 6.90 Both rounded to 2dp	B1 B1	 **ALLOW** incorrect answers as long as given to 2dp
23	(b) (ii)	Two points within ½ square tolerance	B1	**ALLOW** ECF of their calculated values as long as they lie within the grid range
23	(b) (iii)	Line of best fit	B1	The line should pass through all three given points **IGNORE** candidates plotted points
23	(c)	Evidence of use of at least half of the line in calculation of gradient Evidence of calculation of gradient of their line using a pair of points Identify that gradient = ρ / A Area = $\pi d^2/4$ = ρ / gradient, so $d = \sqrt{\frac{4 \times \rho}{\pi \times \text{gradient}}} = \sqrt{\frac{4 \times 5.00 \times 10^{-7}}{\pi \times 9.9}}$ $d = 2.5 \times 10^{-4}$ (m)	B1 B1 C1 A1	Attempt at calculation of gradient from a single point cannot score either B mark Expect 0.099 (Ωcm^{-1}) or 9.9 (Ωm^{-1}) Accept 0.1 (Ωcm^{-1}) and 10 (Ωm^{-1}) ECF from their line of best fit (b)(iii) **ALLOW** ECF from their value of gradient

Question		Answer	Mark	Guidance
				Evaluation correct with data used to at least 2 significant figures Expect $2.4 \times 10^{-4} – 2.6 \times 10^{-4}$
23	**(d)**	Any two points from: • (Sharp) point reduces uncertainty (in positioning) • Use of (clear) ruler reduces parallax error • The ruler records in mm so is high resolution	M2	
		(Lead to) an accurate reading for length (of wire)	A1	One of the M marks is required to allow access to the A mark

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