

A-level Physics

PHY3T/P14

Final Marking Guidelines

2450/2455

June 2014

Version/Stage: 1.0 Final Marking Guidelines

Guidance for teachers marking Physics ISAs

The marking guidelines have been devised by a team of experienced examiners. They have tried to anticipate all possible responses worthy of credit. In order to establish consistency it is essential that all centres mark exactly to this scheme.

For ease of use the mark scheme has been presented in tabular form. Concise answers are given in the left-hand column. More detailed explanatory notes for some questions are included in the right-hand column.

Marking of Stage 1 of the ISA – student data and graph – should ideally be completed before the ISA written test to ensure that candidates do not change any data. (Alternatively, centres should take other steps to ensure that candidates do not change any information on their data script/graph). The marking of this section should be annotated with a red tick at the point where the mark has been awarded together with the letter referring to this mark scheme, eg '✓b'. **No other comments or feedback should be written on the candidates' scripts.** The total mark for this section should be written at the top of the paper. This will be transferred to the grid on the front page of the ISA test booklet.

Marking of the ISA test should be done using a red tick to represent each mark awarded. Further annotated comments **can** be added where necessary as an explanation as to why a particular point has been awarded which will greatly aid the moderation process. The total mark for each question should be entered on the grid on the front cover of the ISA booklet and the total mark calculated.

Assessment Advisers are allocated to each centre and they can advise on the marking process. You should receive the contact details for the Assessment Advisor through the post. If you have not received them, please contact the AQA subject team.

A ISA Resistor characteristics

Stage 1			Additional Guidance
(a)	Correctly setting up the circuit as given in the diagram ✓	1	This mark cannot be awarded if any help has been given in setting up the circuit but Ignore help due to faulty equipment and safety checks.
(b)	Separate tables for R_A , R_B and R_A and R_B in parallel, with column headings showing all recorded results for V , I Allow a single table provided results for each resistor and the parallel combination are clearly labelled. All units for V , I , correct, and only in column headings. ✓	1	Column headings can either be in words or standard symbols. Units can be in words or the correct abbreviation. e.g. current/amperes, //A. Allow also units in brackets e.g. I (A), current (amperes), current in A, current in amperes etc. Do not allow units in the body of the table.
(c)	Decimal places correct for all current and pd readings, compatible with precision of ammeter and voltmeter. ✓ This mark can only be awarded if the precision of the instruments are quoted together with the appropriate units.	1	
(d)	At least 7 different values of pd and corresponding current values covering a range of pd of at least 2.5 V for all three combinations ✓ The maximum pd should not exceed 4 V.	1	Provided the candidate has done the minimum of 7 readings below 4 V ignore extra readings above 4 V. 0,0 is not an acceptable experimental result in this case.

(e)	<p>Axes labelled with quantity and unit: //A on the vertical axis and V/V on horizontal axis</p> <p>and</p> <p>Suitably large graph scale for results for parallel combination of R_A and R_B (do not award if scale on either axis could have been doubled). Scale must be 'sensible' divisions which can be easily read. E.g. scales in multiples of 3, 6, 7, 9, etc are unsatisfactory ✓</p>	1	<p>Alternative method of labelling axes as in (b) and (c) above for table headings and units. Allow ecf where same unit penalty has already been applied in (c) for incorrect unit but do not award the mark if either unit is missing.</p> <p>Do not award mark if axes wrong way around.</p> <p>N.B. A scale division in 4's might sometimes be acceptable. Examples of acceptable and unacceptable scales in 4's are given in the teachers support section of the website</p> <p>Candidates have been instructed to plot results for resistors R_A and R_B on the same axes. The results for these resistors do not have to meet this criteria.</p>
(f)	<p>Points accurately plotted to within 1 mm ✓</p> <p>Check the 2nd and 5th points for resistor R_A and R_B in parallel.</p>	1	<p>This mark is independent of mark (e), i.e. if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points.</p>
(g)	<p>Straight lines of best fit drawn for all 3 graphs. All three lines must meet the criteria ✓</p>	1	<p>To award the mark the lines should be straight lines with approximately an equal number of points on either side of each line. Points which are obviously anomalous should not unduly influence the line.</p> <p>All three lines are required for the one mark.</p>

	Total	7	
--	--------------	----------	--

Section A			
1(a)	Current or I ✓	1	
1(b)(i)	Uncertainty in $V = (\pm)$ precision of voltmeter Uncertainty in $I = (\pm)$ precision of ammeter ✓ both correct with unit for 1 mark	1	No penalty for omitting \pm . No sf penalty If instrument precision has not been stated allow use of precision of voltmeter and ammeter if it is consistent with the decimal places in stage 1(c)
1 (b)(ii)	Largest V and I values from the results for resistor R_A quoted. ✓	1	Accept a reference to largest values in the table for R_A without actually quoting the figures.
1 (b)(iii)	Correct computation of percentage uncertainties in V and in I ✓ Correct % uncertainty in resistance (based on adding together % uncertainties in V and I) quoted to 1 or 2 sf. ✓	2	Allow ecf from incorrect choice of max values of V and I from 1(b)(ii) Allow ecf from % uncertainties in first part of 1(b)(iii) No penalty for omission of \pm
1 (c)(i)	Correct computation for values of R_A ✓ and R_B . ✓ <u>from a single point on each line.</u> Deduct 1 mark if unit is missing on either answer Deduct 1 mark if either of the points chosen < half the maximum pd	2	Must be a point on the line No marks awarded here for any gradient calculation. No sf penalty.

1(c)(ii)	Correct computation of parallel resistance using the formula. ✓	1	No sf penalty. Allow ecf from 1(c)(i) No penalty for omitting unit.
1(c)(iii)	Correct calculation of parallel resistance from the graph. Unit required. (This can either be by measuring the gradient of the graphs or by computation of a single value of $\frac{V}{I}$) ✓	1	Calculation from a single point on the graph is expected but allow value from gradient since this was not explicitly excluded in the question.
1(c)(iv)	Calculation from graph is more reliable because uncertainty depends on data from a single measurement of resistance. ie 5% uncertainty Using formula requires two resistance measurements with a total uncertainty greater than 5 % ✓	1	
1(d)	Candidate states they would use graph to find resistance at a range of different I values by calculating resistance for each individual point on the graph. ✓ Graph (or calculations) should show that resistance is constant at first and then increases with increasing current ✓	2	NB Since graph is a curve resistance cannot be calculated from gradient, BUT , accept response that over initial straight section resistance could be found from gradient but then makes it clear that over curved section resistance must be calculated from individual points. Accept response that resistance increases with increasing current provided candidate has not made reference to initial linear section of graph in previous marking point
		12	

Section B			
2(a)	$1/d^2$ values: 4.73, 6.93 R values: 3.13, 4.55 ✓	1	Exact values only to same number of sf as other data in each column.
2(b)	Both points correctly plotted to within ± 1 mm or less from exact position ✓ straight line of best fit drawn ✓	2	Same criteria for the straight line as in stage 1
2(c)	Triangle drawn with smallest side at least 8 cm ✓ correct values <u>read</u> from graph ✓ gradient in range 0.635 – 0.684 (unit not required) must be to 2 or 3 sf ✓	3	Gradient must lie within limits stated. No ecf from incorrectly read values unless it falls within stated limits. No unit penalty.

2(d)(i)	<p>Straight line <u>through origin</u> shows R is (directly) proportional to $1/d^2$ ✓</p> <p>A is proportional to d^2 or $A = \pi d^2/4$, this shows R is proportional to $1/A$ ✓</p>	2	<p>Allow if candidate has substituted d^2 into the formula to show R is proportional to $1/d^2$</p> <p>Also allow if candidate has referred to $y = mx$ and stated what y and x represent</p>
2(d)(ii)	<p>Formula rearrangement</p> <p>$\rho = (\text{gradient} \times \pi)/4 \times \text{length}$ OR $\rho = 0.66 \times \pi / 4 \times 1000$ (using mm) $= 0.66 \times 10^{-6} \times \pi / 4 \times 1$ (using m) ✓</p> <p>$0.52 \times 10^{-6} \Omega\text{m}$ or $0.52 \times 10^{-3} \Omega\text{mm}$, with correct unit ✓</p>	2	<p>Allow mixture of m and mm in first marking point</p> <p>For 2nd marking point answer can be where lengths and area have used mm and mm^2 or where m and m^2 but not where a mixture of m and mm are used. Allow ecf from gradient value.</p> <p>Answer should be at least 2 sf</p>
2(e)(i)	<p>Use micrometer (screwgauge) ✓</p> <p>Measure at several places along the wire and find mean or take diameter measurements at different angles around wire and find mean ✓</p>	2	
2(e)(ii)	<p>Zero error in micrometer ✓</p> <p>Close micrometer jaws and zero instrument or add or subtract to correct subsequent readings. ✓</p>	2	<p>If candidate has stated this answer in 2(e)(i) they can be awarded both marks</p>

2(f)(i)	Diameter contributes most because % uncertainty in area (\pm) 4% or diameter is squared so % uncertainty in area is double (\pm) 4% ✓	1	
2 (f)(ii)	Correct calculation of % uncertainty in ρ shown by adding together individual % uncertainties (from 0.5% + 3% + 2% +2%) ✓ Correct answer for uncertainty in ρ from candidates value of ρ from (d)(ii) (using answer above/100 x value of ρ) Must be to 1 or 2 sf ✓	2	No sf penalty for intermediate % uncertainty value Unit not required
	Total	17	

Question 3			
3a	Resistance of cable is inversely proportional to number of strands because it's like adding resistors in parallel or Number of strands is proportional to area. Resistance is proportional to $1/A$ and hence to $1/n$	1	Accept mathematical explanation: $\frac{1}{R} = \frac{n}{r}$ So $R \propto \frac{1}{n}$ $r =$ resistance of strand $R =$ total resistance of the cable

<p>3b</p>	<p>(A) correct basic procedure – measure total resistance for same length of different numbers of wires clipped together in parallel</p> <p>(B) resistance measurement with ohm-meter</p> <p>(C) Using an ohm-meter a consideration of resistance of connecting leads or ‘zeroing’ of scale to account for resistance of leads</p> <p>(D) graph of total resistance R_T against $1/n$ (where n is the number of wires) - would expect to be a straight line or statement that R_T is proportional to $1/n$</p> <p>(E) Suggest possible ohmmeter (or ammeter and voltmeter) ranges to use. eg Assuming 10 strands 1m long, ohmmeter range 0.1 to 1.0 Ω required</p> <p style="text-align: right;">✓✓✓✓ max 4</p>	<p>4</p>	<p>.</p> <p>(B) Also allow resistance measurement with ammeter and voltmeter.</p> <p>(C) For candidates using an ammeter and voltmeter an alternative marking point would be; keep current low when taking measurements of resistance to avoid overheating</p> <p>(E) Credit any valid attempt to use data given to work out voltmeter OR ammeter range eg realisation that a very small pd must be used and ammeter will have to measure mA (eg ammeter 0 – 100mA)</p> <p>Marks can be only awarded for the marking points stated Put reference letter for each marking point where each mark is awarded.</p>
	<p>Total</p>	<p>5</p>	