General Certificate of Education

Physics

Investigative Skills Assignment (ISA) Q

PHY3T/Q11/mark
Written Test

Final Marking Guidelines

2011 examination – June series

Marking Guidelines Explanatory Notes

The marking guidelines should be considered a working document. A version of the marking guidelines will be placed on the Secure Key Materials Website in September. This is to allow centres to undertake ISA practical's as soon as they wish. Centres can use this version of the marking guidelines to mark candidates work. However this version of the marking guidelines may be subject to amendments. An updated version of the marking guidelines to be used during the present academic year will be placed on the Secure Key Materials Website by **31st October**. Examination Officers must ensure that Teachers receive the final version of the marking guidelines. **Centres should ensure that their marking is in line with the updated version of the marking guidelines.**

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.

Further guidance and information about the marking guidelines will be given at the teacher support meetings which will be held in the later half of autumn 2010. Assessment Advisers are also allocated to each centre and they can also advise on the marking process.

Changes from the previous version are side-barred on the appropriate side of the marking grid.

ISA (Q) Resistivity of a Metal Wire

Stage 1		Mark	Additional guidance notes
(a)	Circuit completed correctly without help ✓	**1**	
(b)	Correct precision recorded for both the ammeter and the voltmeter **including unit** ✓	**1**	
(c)	All lengths must be recorded to the nearest mm. ✓	**1**	
(d)	Table with column headings showing all recorded results and a column for resistance ✓	**1**	Column headings for the variables can be either in words or standard symbols.
(e)	**All** units correct in column headings ✓	**1**	Units can be in words or the correct abbreviation. Standard notation for quantity and unit is expected (eg current / A) but accept units given inside brackets or other notation if the meaning is clear. *Do **not** award this mark if the units are written in the body of the table.* *Do **not** accept lower case symbols* (a, v) *for amperes and volts.*
(f)	At least 7 different lengths recorded with a minimum range of 60 cm and *V* recorded for each length with correct precision ✓	**1**	
(g)	Correct calculation of resistance ✓	**1**	No significant figure penalty. *Check the second and last calculations.*
(h)	Suitably large graph scale (do not award if scale on either axis could have been doubled). Scale must have sensible divisions which can be easily read (eg not in multiples of 3, 4, 7 etc) ✓	**1**	The plotted points should occupy more than half of each axis. Candidates may need to start either axis from a non-zero value to ensure the points occupy a suitably large area of the grid.

ISA (Q) Resistivity of a Metal Wire

(i)	Axes must be clearly labelled with **both** quantity and unit ✓	**1**	*R* must be plotted on the vertical axis. Allow error carried forward for incorrect unit(s) from the table but **no unit: no mark**
(j)	Points accurately plotted to within 1 mm ✓ *Check only the second and third plotted points*.	**1**	This mark is independent of mark (h), ie candidates who have used an unsuitable scale can still achieve the mark for accurate plotting.
(k)	Well drawn straight line of best fit ✓	**1**	The line is expected to pass through the origin but should not be forced to do so. It should have a well-judged gradient with an even scatter of points on each side. Points which are obviously anomalous should not unduly influence the line drawn.
	Total	**11**	

ISA (Q) Resistivity of a Metal Wire

Section A		Mark	Additional guidance notes
1(a)	Correct statement with valid reference to a straight line ✓ Reference to the line passing through the origin ✓	**2**	Example *2 mark* answers: *"My graph does not support this since the straight line does not pass through the origin"* *"My graph supports the theory because it is a straight line which passes through the origin"*
1(b)	Uncertainty stated between ± 2 mm and ± 5 mm inclusively with unit ✓ with a valid comment ✓	**2**	Condone missing ±. *Valid comments:* ***accept any of the following –*** Reference to the connection at X and/or the size of the crocodile clips **OR** reference to two uncertainties for a distance measurement **OR** reference to the wire getting hot / wire expanding **OR** reference to kinks in the wire
1(c)(i)	± (quoted precision for ammeter ÷ 0.5) × 100% ✓	**1**	Accurate calculation needed with no sf penalty Condone missing ± and missing % sign
1(c)(ii)	± (quoted precision for voltmeter ÷ smallest pd) × 100% ✓	**1**	Accurate calculation needed with % sign and max 3 sf Condone missing ± but not missing % sign
1(c)(iii)	Candidate's answers to 1(c)(i) and 1(c)(ii) added together	**1**	Accurate calculation needed with **maximum 2 sf** in answer ***NOTE*** *not 3 sf because this is a % uncertainty estimate* Condone missing ± and missing % sign
1(d)	Gradient of graph = R / l ✓ Measure the diameter of the wire <u>to find the area of cross section</u> ✓ Use a micrometer (screw gauge) ✓ Resistivity = gradient × cross-sectional area ✓	**4**	The first mark can be awarded if this is clearly implied within the candidate's explanation.
	Total	**11**	

ISA (Q) Resistivity of a Metal Wire

Section B		Mark	Additional Guidance Notes
2(a)	<table><tr><td>0.449</td><td>0.158</td><td>6.3</td></tr><tr><td>0.499</td><td>0.196</td><td>5.1</td></tr></table> ✓✓	**2**	**Exact answers only** but accept 6.33 and 5.10 since 3sf can be justified as a larger value of *d* is being measured.
2(b)	Both points plotted correctly ✓ Best straight line drawn ✓	**2**	Allow ecf from 2(a) if values there are wrong. The line should be a straight line with approximately an equal number of points on either side of the line. Points which are obviously anomalous should not unduly influence the line.
2(c)(i)	Gradient triangle drawn with a base at least 8 cm or 8 grid squares in length ✓ Correct readings from the line for the triangle ✓ Gradient = 0.49 ± 0.02 quoted to 2 or 3 significant figures ✓	**3**	The size of the triangle can be implied by readings taken from the line. *Award gradient value mark if within range, even if the correct readings mark was not awarded.*
2(c)(ii)	Ω mm^2	**1**	Accept Ω m^2 or Ω cm^2 if value appropriate
2(c)(iii)	ρ = gradient ÷ 1.100 ✓ gradient = candidate's value × 10^{-6} ✓ $\rho = (4.45 \pm 0.20) \times 10^{-7}$ Ω m ✓	**3**	This is a *show that* question so each step must be explicit to gain the mark with the final answer quoted to two or more sf. However ecf from 2(c)(i) can be allowed. Unit not required
2(d)(i)	± 0.002 mm ✓	**1**	Exact answer only. Unit is required.
2(d)(ii)	% δd = (±) 0.5% ✓ % δl calculated using candidate's value and L = 1.1, together with a correct statement of which is the larger ✓	**2**	
	Total	**14**	

Question 3		Mark	Additional Guidance Notes
3	***Where alternatives are indicated award only one of the marks.***		*Please note, next to your tick, the letter corresponding to the marking point being awarded* (*eg* ✓ a).
	(a) Connect the multimeter to the wire using the long leads and crocodile clips **OR** (b) Keep the distance between the clips constant throughout the experiment ✓	**1**	
	(c) Take readings with the multimeter for at least seven different weights ✓	**1**	
	(d) Take readings increasing the load on the wire and repeat readings unloading the wire **OR** (e) plot a graph of resistance against weight ✓	**1**	
	(f) Wear safety goggles in case the wire snaps **OR** (g) Take care when climbing up to hang the wire **OR** (h) Be careful not to drop the weights on your foot ✓	**1**	
	(i) Measure the resistance of the connecting leads and crocodile clips and subtract this value from the wire resistance readings **OR** (j) Set meter to zero with leads connected ✓	**1**	
	Total	**5**	