A-level
Physics
PHY3T/Q14
Final Marking Guidelines

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Guidance for teachers marking Physics ISAs

These are the **Stage 1 Marking Guidelines,** which provide guidance on the marking of Stage 1 of the ISA. The full **Marking Guidelines** will be published on eAQA in March 2014.

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.

Stage 1		Mark	Additional guidance notes
(a)	Table with column headings showing all recorded results and correct units, columns for sines of angles ✓	**1**	Column headings can either be in words or standard symbols. Units can be in words or the correct abbreviation. e.g. Allow also units in brackets e.g. d (cm), d in mm etc.
(b)	Correct calculation of means and sines, checking 2nd and 5th lines in table ✓	**1**	No sig fig penalty on sines and means provided all means and all sines are quoted to the same number of sf's.
(c)	Decimal places in raw data compatible with precision of instruments ✓	**1**	Do not award this mark if the precision of the protractor has not been stated as instructed in the task sheet.
(d)	Minimum of 7 readings ✓	**1**	
(e)	Large graph scale (do not award if scale could be doubled on either axis). . Scale must be 'sensible' divisions which can be easily read. E.g. scales in multiples of 3, 6, 7, 9, etc are unsatisfactory **and** Correctly labelled axes and units ✓ d/h must be plotted vertically	**1**	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 N.B. Both plotted quantities should have no units and candidates should be penalised if they incorrectly introduce a unit on either axis.
(f)	2nd and 5th points plotted to ± 1 mm ✓	**1**	
(g)	Line of best fit drawn not forced through origin ✓	**1**	To award the mark 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
	Total	**7**	

Section A		Mark	Additional guidance notes
1(a)	Angle of incidence or θ ✓	**1**	
1(b)(i)	Correct calculation of **both** uncertainty in largest mean value of d and largest mean value of *h* *(*using 0.5 x spread of repeats) Unit required ✓	**1**	If repeat readings are identical, uncertainty is ± 1mm No penalty for missing ± No sf penalty
1(b)(ii)	Correct calculation of % uncertainties of *d* and *h* ✓ Addition of these for % uncertainty in *d/h* ✓ correct answer for uncertainty in *d*/*h* (using $\frac{d}{h}$ x % $\frac{\text{uncertainty in } d/h}{100}$) ✓	**3**	Allow ecf from (b)(i) Allow min/max method of calculating uncertainty No penalty for missing ± or % symbol Allow ecf from previous part of b(ii) Final answer to only 1 or 2 sf
1(c)	Graph is a straight line <u>through</u> origin, ✓ so *d/h (*directly) proportional to sin θ ✓	**2**	If candidate's graph does not go through the origin, this must be acknowledged and the quantities must be described as having a linear relationship (and not having a proportional relationship) If a line is very close to the origin and a candidate has acknowledge that this is within experimental error the first marking point can be awarded
1(d)	Rearrangement to show $\frac{d}{h} = \frac{\sin\theta}{n}$ (Above formula is of form $y = mx + c$) ✓ With gradient (m) is constant so it is a straight line **and** c=0 so no intercept ✓	**2**	
1(e)	1/refractive index of glass **or** (refractive index of glass)$^{-1}$ **or** refractive index of air relative to glass ✓	**1**	No mark for stating 1/n
1(f)	Results are reliable because repeat values are close **and** points are close to line of best fit. ✓	**1**	Or converse if results are not reliable.
	Total	**11**	

Section B		Mark	Additional guidance notes
2(a)	0.284, 0.334, 0.383 Exact values only ✓	**1**	
2(b)	3 points all plotted to ± 1 mm ✓ Line of best fit ✓	**2**	Criteria for line of best fit same as in Stage 1 (g)
2(c)	Large gradient triangle with smallest side at least 8 cm ✓ Correct values <u>read</u> from graph ✓ Correct value of gradient (within range 0.645 to 0.694) ✓	**3**	 Allow 2 or 3 sf only. No ecf from values read unless gradient falls within range stated.
2(d)(i)	n_2 / n_1 = 1/gradient or correct data substitution ✓ correct value (approximately 1.5) ✓	**2**	 ecf from incorrect gradient value
2(d)(ii)	Calculation of range of values for this type of glass (within 2%) is 1.59 to 1.65 ✓ Point out if their value is within this range ✓ Concludes whether or not it might be the same type of glass, allowing for some uncertainty in the measured result ✓	**3**	Alternative: If the candidate has calculated the % difference between 1.62 and their own value ✓ Then pointed out it is greater (less) than 2% ✓ Concludes whether or not it might be the same type of glass, allowing for some uncertainty in the measured result ✓ Allow ecf from 2(d)(i)
2(e)	Take more repeat readings Measure distances and use trig Use a vernier scale for angles Use laser light ✓✓ 2 marks max	**2**	Allow other valid alternatives.
	Total	**13**	

Section B		Mark	Additional guidance notes
3(a)	20.0°, 19.0° ✓	**1**	Values must be exactly as shown
3 (b)	0.326 to 0.342 ✓	**1**	Minimum 3 sf
3(c)	(0.008/0.334) x 100 = (±) 2.4% ✓	**1**	No penalty for missing ± Allow 1 or 2 sf
3(d)	% uncertainty in $\sin\theta$ is smaller at larger angles ✓	**1**	
	Total	**4**	

Section B		Mark	Additional guidance notes
4 (a)	(A) White light from raybox passed through filter and directed through glass block at varying angles of incidence (B) Measure θ_1 and θ_2 and plot a graph of sin θ_2 against sin θ_1 to find refractive index as the inverse of the gradient (C) Repeat for other filters (D) Plot refractive index against transmitted wavelength ✓✓✓ 3 marks max	**3**	Allow alternative methods of measuring refractive index (eg methods using TIR) (B) if graph is plotted sin θ_1 against sin θ_2 then gradient is the refractive index Annotate script with letter corresponding to the marking point awarded.

4 (b)	(A) light from filter passed through diffraction grating of <u>known line spacing</u> (B) measure angle of diffraction for <u>specified order</u> **and** use formula to calculate wavelength. (C) Improved technique in measuring angle either by measuring 1st order (or other order) on both sides and halving to get angle **or** measuring angles for several orders of diffraction pattern to find mean value of wavelength (D) Recognition that illuminating filter with white light might give more than one wavelength/line on diffraction pattern **and** suggests using most prominent line ✓✓✓ 3 marks max	**3**	NB Statement of diffraction grating formula NOT required (C) using a spectrometer with vernier angle scale Annotate script with letter corresponding to marking point awarded.
	Total	**6**	
	Total	**34**	