



**General Certificate of Education (A-level)
June 2012**

Physics

Investigative Skills Assignment (ISA Q)

PHY6T/Q12/mark

Written Test

Final

Marking Guidelines

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**. Examinations 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 2011. Assessment Advisers are also allocated to each centre and they can also advise on the marking process.

ISA (Q) U-Tube Oscillations

Stage 1		Mark	Additional guidance notes
(a)	Single table with column headings, including correct units, showing at least five recorded values for volume and time ✓ <i>Significant figures for volume and time must match instrument precision and be consistent throughout the table.</i>	1	Column headings can be either in words or appropriate symbols. Units can be either in words or the correct abbreviation. eg accept ml or cm ³ for the volume unit, but do not accept sec ² in place of s ² . Standard SI notation is preferred to separate the quantity from its unit, eg volume/cm ³ , but accept alternatives such as 'volume (cm ³)' if the meaning is clear. <i>This mark cannot be awarded to candidates who include units in the body of the table.</i>
(b)	Repeat readings for time with a minimum timing period of 5T ✓	1	Because of damping, it may be difficult to observe more than five oscillations. At least three recorded measurements of at least 5T for each volume are required.
(c)	At least three readings for internal diameter of the tube recorded, and the average found correctly and quoted with unit ✓ Accept 2 or 3 sf only.	1	<i>Candidates were told to measure both sides of the U-tube.</i>
(d)	Correct method used for calculating length and the length recorded in the table for each volume ✓	1	Verify correct use of <i>length = volume over area of cross-section</i> for the first value of <i>l</i> which is expected to be about 65 cm.
(e)	T^2 recorded for each volume of water/checking first and last value ✓	1	Ignore sf and unit.
(f)	A graph of T^2 against <i>l</i> , with <i>l</i> on the horizontal axis. 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 scales in multiples of 3, 4, 6, 7, 9 etc are not acceptable. Both axes must be labelled with quantity and unit ✓	1	The candidates were instructed to plot <i>l</i> on the horizontal axis. The plotted points should occupy more than half of each axis. For the axes labels the same convention as for table headings is required. Allow ecf from (a) for incorrect unit but do not award the mark if either unit is missing.

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(g)	Points accurately plotted to within 1 mm. <i>Markers should check the first and last plotted points.</i> Accurate best fit straight line drawn ✓	1	This mark is independent of mark (f), ie if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points. The best fit line should accurately reflect the trend indicated by the points with an even scatter of the points on either side.
Total		7	

Section A		Mark	Additional guidance notes
1(a)	The graph shows proportionality or linearity ✓ Valid reference to the origin ✓	2	The marks in this question are for the candidates clearly demonstrating their awareness that for (<i>direct</i>) <i>proportionality</i> the graph must be a straight line which also passes through the origin . <i>A candidate who claims that the relationship is directly proportional when the graph does not pass through the origin gets no marks.</i> Example 2 mark answers: eg 1 – T^2 is (<i>directly</i>) <i>proportional to l</i> because the graph is a straight line passing through the origin. eg 2 – The increase in T^2 with l is linear but not directly proportional since the line does not pass through the origin. eg 3 – Within experimental error, T^2 seems to be directly proportional to l since the line passes very close to the origin.
1(b)	Find the <u>gradient</u> of the line ✓ $g = \frac{2\pi^2}{\text{gradient}}$ ✓	2	
1(c)	(i) $\frac{1}{2} \times$ range of readings if repeats recorded or precision if no repeats or for identical repeats ✓ (ii) $\frac{1}{2} \times$ range of values for T ✓ (iii) % uncertainty in l due to measurement of $d = 2 \times$ %uncertainty in d ✓ % uncertainty in $T^2 = 2 \times$ % uncertainty in T ✓ % uncertainties compared and consistent statement made ✓	5	<i>All five marks are independent. Allow ecf on all parts.</i> Penalise missing units in either part (i) or part (ii) but do not penalise twice. The first two marking points in part (iii) can be implied by the working shown. <i>No sf penalty in any part of this question.</i>

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2(d)	Triangle drawn with smallest side ≥ 8 cm and correct values read from the best fit line ✓ Gradient in range -0.49 to -0.51 answer to 2 or 3 sf ✓✓ Accept 2 or 3 sf only for the answer. <i>1 mark for number within range and 1 mark for the minus sign.</i>	3	No unit penalty.
2(e)	(i) Recognition that $1/n$ is related to the gradient ✓ $n = -2$ ✓ <i>Exact answer only.</i> (ii) T in range 1.41 to 1.43 (s) ✓ $k = 1.42 \div (1000)^{-1/2} = 44.9$ ✓ (iii) $\text{kg}^{1/2} \text{m}^{-3/2} \text{s}$ ✓ (iv) $T = 44.9 \times (3.10 \times 10^3)^{-1/2} = 0.806 \text{ s}$ ✓	6	The answer $n = 2$ implies the first mark in (i). No unit or sf penalty for T in (ii) but accept 2 or 3 sf only for k . Allow ecf in k for incorrect or out of range T , and/or alternative method giving correct answer for k . Allow ecf from (ii) for answer in (iv). No sf penalty.
	Total	15	

ISA (Q) U-Tube Oscillations

Section B		Mark	Additional guidance notes
3	(a) A set of U-tubes with different diameters to be used (b) Reference to temperature kept constant (c) Reference to length of water column kept constant (d) Reference to the measurement of the mean position of the oscillations (e) Realistic method for measuring amplitude (f) Clear statement of how results will be presented. eg a graph of <u>amplitude ratio against tube diameter</u> ✓✓✓✓ 4 marks max	max 4	<p><i>Please record, next to your tick, the letter corresponding to the marking point being awarded (eg ✓a).</i></p> <p>Acceptable methods for amplitude measurement include</p> <ul style="list-style-type: none"> • Vertical scale marked along one side or behind the tube • Video (camera) <u>recording and playback</u> measurements • Data logging using a <u>position sensor</u> connected to a <u>computer</u>
	Total	4	