Version 1.0

General Certificate of Education (A-level)
June 2012

Physics

Investigative Skills Assignment (ISA P)

PHY6T/P12/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 centre's 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 (P) Cooling Water

Stage 1		Mark	Additional guidance notes
(a)	d = 2.6 ± 0.1 cm **and** h = 2.1 ± 0.1 cm together with evidence of repeat readings ✓	**1**	These readings must be clearly identified by a label or comment and be expressed to the nearest mm with the unit given.
(b)	Sensible values recorded for θ_S, θ_A and θ_B *with unit* ✓	**1**	θ_A must be at least 5°C greater than θ_B.
(c)	Single table with column headings, including correct units, showing all recorded results for temperature, θ, and time, *t, in seconds* ✓	**1**	Column headings can be either in words or appropriate symbols. Units can be in words or the correct abbreviation. There must be a suitable separator between the stated quantity and its unit, eg θ/°C. This mark cannot be awarded to candidates who include units in the body of the table. 'secs' is not allowed as an abbreviation for seconds.
(d)	At least ten sets of readings for θ and t, including t = 0 and t = 600 s ✓	**1**	Temperature values consistent with thermometer precision.
(e)	A graph of θ against t, with θ on the vertical 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 plotted points should occupy over half of each axis. For axes labels, the same convention as for table headings is required. Allow ecf from (c) for incorrect unit but do not award the mark if either unit is missing. *Note: a scale which progresses in 30 s or 1 minute intervals is not acceptable.*
(f)	Points accurately plotted to within 1 mm ✓ *Markers should check the first and last plotted points.*	**1**	This mark is independent of mark (e), ie if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points.
(g)	Best fit curve well drawn ✓	**1**	This should be a smooth, shallow curve with the points evenly scattered about the line.
	Total	**7**	

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Section A		Mark	Additional guidance notes
1(a)	Correct values of θ taken from the candidates **line** of best fit for t = 500 s and t = 100 s ✓ (θ_{500} - θ_{100})/400 calculated correctly and unit given ✓	**2**	No sf penalty.
1(b)	(i) Draw a tangent to the curve at t = 300 s **and** find its gradient ✓ (ii) The second box should be ticked ✓	**2**	Mark (i) can be awarded if the candidate has actually drawn the correct tangent and attempted to find its gradient. Do not award mark (ii) if a best fit line has not been drawn or the graph does not show a temperature decrease with time. If the candidate has drawn a best fit *straight* line with a negative gradient then award this mark if the first box has been ticked.
1(c)	Unit must be included and quoted to 2 or 3 sf ✓	**1**	
1(d)	%uncertainty in h and r calculated correctly using the candidates values for h and d ✓ 2 × %uncertainty in r or d added to %uncertainty in h ✓ 6% < δV_{10} ≤ 7% ✓ Final answer to 1 or 2 sf only.	**3**	Expected values: δh = ± 4.8%, δr = ± 0.77%. The answers do not require a ± sign. No penalty if % sign omitted.
1(e)	800 ≥ c ≥ 300 ✓ unit for c given as J kg^{-1} K^{-1} or J kg^{-1} °C^{-1} ✓	**2**	No significant figure penalty here.
1(f)	(a) Uncertainty in temperature differences **twice** the precision ✓ (b) %uncertainty of ($\theta_A - \theta_B$) & ($\theta_B - \theta_S$) calculated and added to give % uncertainty in $\frac{\theta_A - \theta_B}{\theta_B - \theta_S}$ ✓ (c) Contributing % uncertainties of thermometer and ruler measurements compared ✓ (d) Consistent conclusion stated ✓	**4**	These marks are independent, therefore allow ecf between marking points. Accept any reasonable estimate for percentage temperature difference ratio uncertainty: no calculation necessary. It must be clear for the third mark that percentages are being compared. Please identify marking points (eg ✓(a)).
	Total	**14**	

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Section B		Mark	Additional guidance notes
2(a)	The data logger measures and records both variables <u>simultaneously</u> whereas there would be uncertainty due to the delay between reading the clock and then the thermometer ✓	**1**	The mark should be awarded if the candidate refers to the difficulty of reading the thermometer **and** the clock at the same time.
2(b)	<table><tr><td>22.5</td><td>3.114</td></tr><tr><td>21.7</td><td>3.077</td></tr><tr><td>20.6</td><td>3.025</td></tr></table> ✓ All six values correct. *Exact answers only.*	**1**	
2(c)	Points accurately plotted to within 1 mm ✓ Accurate best straight line drawn ✓	**2**	All three points must be accurately plotted. *Assess the line of best fit very carefully.*
2(d)	When <u>natural</u> logs are taken of both sides the formula becomes $\ln\phi = \ln\phi_0 - kt$ ✓ When $\ln\phi$ is plotted against t a straight line with <u>negative gradient</u> is expected ✓	**2**	Use of naturals can be implied by the equation. The equation must be quoted for the 2nd mark.
2(e)	Triangle drawn with smallest side <u>≥</u> 8 cm <u>and</u> correct values read from the best fit line ✓ Gradient in the range from – 0.0083 to – 0.0087 ✓✓ *1 mark for number within range and 1 mark for the minus sign.*	**3**	Accept 2 or 3 sf only for the answer. No unit penalty.

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2(f)	• Same numerical value as the candidate's answer for the gradient • With the <u>opposite sign</u> • s^{-1} given as the unit **All three marking points correct = 2 marks** **Any two marking points = 1 mark** **Otherwise no marks**	**2**	
2(g)	(i) Must have unit and to 2 or 3 sf. Answer in range 31 to 34°C ✓ (ii) Candidate's value for ϕ_0 correctly multiplied by candidate's value for k ✓ (iii) Answer in range 0.15 to 0.19°C s^{-1} ✓. Unit required and answer to 2 or 3 sf.	**3**	(ii) No sf or unit penalty here. Expected value around 0.3. (iii) Unit K s^{-1} also acceptable.
2(h)	Allow the body to cool for a much longer time ✓ Repeat the experiment with a much larger initial temperature difference ✓	**2**	
	Total	**16**	

ISA (P) Cooling Water

Section B			
3	(a) Statement to the effect that the cooling experiments have to be performed both with and without a cover (b) The same volume of hot water must be used each time (c) The test must be performed at each initial temperature both with and without the cover (d) A range of initial temperatures should be investigated (e) Same time of cooling or same fall in temperature should be used for each test (f) The difference in temperature loss (or difference in time to cool) with the cover and without the cover should be plotted against initial temperature to show the variation being investigated ✓✓✓✓ 4 marks max	**Max 4**	***Please record, next to your tick, the letter corresponding to the marking point being awarded (eg ✓a).***
	Total	**4**	