General Certificate of Education

Physics

Investigative Skills Assignment (ISA) Q

PHY6T/Q10/mark
Written Test

Marking Guidelines

2010 examination – June series

WMP/Jun10/PHY6T/Q10/mark

Marking Guidelines Explanatory Notes

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, e.g. '✓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 marks 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.

ISA (Q) Absorption and Attenuation of Radiation

Stage 1		Mark	Additional guidance notes
(a)	If **no help** was given setting up the apparatus and R_0 was correctly calculated ✓	**1**	Repeat readings not required here.
(b)	Table with column headings (quantity/unit) for n, I and V showing all the raw data collected ✓	**1**	For this mark the candidate must produce a single well-presented table of results. Column headings can be either in words or standard symbols. Units can be in words or the correct abbreviation. e.g. resistance/ohms, R/Ω. Alternative acceptable labelling includes resistance (Ω), R (Ω).
(c)	Data for n = 1, 2, 3, 4, 5, 6 i.e. at least 6 values for n ✓	**1**	
(d)	Evidence of repeat readings for resistance determination. ✓	**1**	
(e)	R correctly calculated for all values of n ✓	**1**	This can be calculated either from the mean of repeat readings or from single reading if repeats not taken. Two values checked by marker.
(f)	Raw data presented with the same precision as the instruments used to collect them and consistent significant figures and decimal places given for R ✓	**1**	
(g)	Suitably large graph scale (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, 4, 6, 7, 9, etc. are unlikely to be satisfactory and both axes labelled with correct quantity and unit ✓	**1**	The plotted points should occupy at least half of each axis. Alternative method of labelling axes as in (a) above for table headings and units, e.g. resistance (ohms) etc.

(h)	Most points accurately plotted to within ± 1 mm and a smooth curve drawn with even scatter of points ✓	**1**	This mark is independent of mark (g). i.e. if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points. Markers should check a proportion (typically 2) of plotted points. Allow one incorrect plot in a sample of 6 or 7 plotted points.
	Total	**8**	

Section A		**Mark**	**Additional Guidance Notes**
1 (a)	independent discrete ✓	**1**	More than two terms underlined – no mark.
1 (b)	*R* increases with *n* **and** The increase is not linear ✓	**1**	Both points required (Alternative answers depending on graph shape: *R* increases to a maximum/reaches a plateau/no further increase).
1 (c)	Use a micrometer (screw gauge) ✓ To measure the thickness of a pile of sheets and then divide this measurement by the number of sheets in the pile ✓	**2**	Accept vernier callipers/digital callipers and a large number (at least 100) of sheets – for 1 mark.
1 (d)	Position the paper to be tested between the LDR and the light source and measure the LDR resistance ✓ Look up this resistance on the graph to find the thickness ✓ If the resistance is too high then the paper is too thick / if the resistance is too low then the paper is too thin ✓	**3**	
1 (e) (i)	Intensity of the light (incident on the LDR) ✓	**1**	Accept "brightness of the lamp".

ISA (Q) Absorption and Attenuation of Radiation

1 (e) (ii)	Measure the LDR resistance with each filter in turn ✓ If the LDR is colour sensitive the resistance will vary ✓	**2**	
1 (e) (iii)	The colour filter giving the lowest resistance would be the best to use ✓	**1**	
	Total	**11**	

Section B		**Mark**	**Additional Guidance Notes**
2 (a)	To correct for <u>background radiation</u> ✓	**1**	
2 (b)	To improve the <u>reliability</u> of the measurement C/ repeat readings reduce random error ✓	**1**	Accept 'reduce error'.
2 (c)	$\pm 6\,\text{min}^{-1}$	**1**	Correct answer only needed. ± sign and unit not required for the mark.
2 (d)	% uncertainty in $d = \pm(2/20) \times 100\% = \pm 10\%$ ✓ % uncertainty in d^2 or $1/d^2 = 2 \times (\pm 10\%)$ $= \pm 20\%$ ✓ No sig fig penalty. No penalty for missing ± sign or % sign.	**2**	1st mark can be awarded for either 10% or details of calculation to arrive at 10% answer. 2nd mark can be awarded for answer only. Allow ecf from 2(c).
2 (e)	Mean C: 99, 70 ✓ Values $1/\sqrt{C}$: 0.101, 0.120 ✓ (allow ecf from C values)	**2**	One mark for each column. Allow 2 or 3 significant figures. Must be 3 significant figures.
	Total	**7**	

ISA (Q) Absorption and Attenuation of Radiation

3 (a)	Both points accurately plotted to within ± 1 mm or less. ✓ Line of best fit drawn. (The line must be a straight line, as instructed, with approximately an equal number of points on either side of the line). ✓	**2**	
3 (b) (i)	Triangle drawn with smallest side 8 cm ✓ Correct values read from graph ✓ Answer for gradient = 0.0076 ± 0.0002 (no significant figure or unit penalty) ✓	**3**	Credit can be awarded if triangle not actually drawn, provided data taken from graph coordinates is 'equivalent' to triangle with minimum side 8 cm. Data points coincident with values in the table can only be used for gradient if they fall exactly on the line. Ecf from values read from graph only allowed if gradient falls within stated tolerance.
3 (b) (ii)	k = 0.0076 ✓ Accept 2 or 3 significant figures only unit: $cm^{-1}min^{½}$ (or $m^{-1}min^{½}$ if appropriate for numerical value given) ✓	**2**	Accept answer quoted same as gradient as a recognition that candidate understands k is gradient of graph drawn. (Alternatively k could be calculated from y intercept) Ecf from incorrect gradient value.
	Total	**7**	

4 (a)	Systematic Error	**1**	
4 (b)	d is too small ✓ Because d is negative when $1/\sqrt{C}$ is zero ✓	**2**	Allow explanations which refer to gamma detection taking place at distance inside tube, not at front **or** source is inside mechanical protective enclosure, not at front etc.
4 (c)	e = 1.5 ± 0.3 cm (no unit penalty) ✓	**1**	Answer to 2 significant figures.
	Total	**4**	

ISA (Q) Absorption and Attenuation of Radiation

5 (a)	Radiation spreading equally in all directions would give inverse square relationship / intensity would be proportional to $1/d^2$ ✓ Supports assumption because straight line graph effectively shows $1/\sqrt{C}$ proportional to d, which is same as intensity or count rate C, proportional to $1/d^2$ ✓	**2**	Wording may vary considerably, but 1 mark is awarded for candidate realising radiation spreading out equally is equivalent to an inverse square relationship, and second mark for realising that straight line graph as plotted confirms the inverse square relationship (graph does not pass through origin because of systematic error in d, but no penalty if this point is not explained).
5 (b)	Possible marking points: • measure resistance of LDR at points around lamp and equidistant from it • similar value of LDR resistance indicates same intensity so light spreads out equally in all directions • repeat at different distances to determine if intensity same at all positions around lamp • area of detection window of LDR is same in all positions • recognition that it is not possible to relate resistance values at different distances directly to intensity **2 marks max**	**2**	
	Total	**4**	
	Total	**33**	