General Certificate of Education

Physics

Investigative Skills Assignment (ISA) Q

PHY3T/Q10/mark
Written Test

Marking Guidelines

2010 examination – June series

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) Motion down an Inclined Plane

Stage 1		Mark	Additional guidance notes
(a)	Table with column headings showing all recorded results for distance and time measurements. ✓	**1**	Column headings can be either in words or standard symbols.
(b)	**All** units correct in column headings. ✓	**1**	Units can be in words or the correct abbreviation. e.g. Time/seconds, time/s. Alternative acceptable labelling includes time(s), time in s etc.
(c)	At least 5 different distances and all distances quoted to nearest mm. ✓	**1**	i.e. significant figures on distances must be to nearest mm e.g. a typical distance should be quoted as 400 mm, 40.0 cm or 0.400 m
(d)	Repeat timings for all distances included in the table. ✓ Decimal places in all time readings must be compatible with the precision of the stopclock or stopwatch used.	**1**	Candidates were specifically instructed to take repeat readings. 'Readings' refers to 'raw data' i.e. actual time readings taken, as opposed to 'processed data' such as mean or t^2 values.
(e)	Mean values of t correctly calculated for each corresponding value of s. Significant figures on these mean values should be no greater than the precision of the stopclock or stopwatch. ✓	**1**	Check calculation of at least two mean time values. This does allow **no** penalty for students who have put fewer decimal places on mean time values than stopclock/stopwatch precision.
(f)	t^2 values correctly calculated for all values of s no significant figure penalty ✓	**1**	Check calculation of at least two t^2 values.
(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.) ✓	**1**	The plotted points should occupy at least half of each axis.
(h)	Correctly labelled axes with units ✓	**1**	Both axes labelled with quantity and unit. Words or symbols may be used for physical quantities and units. e.g. $(\text{time})^2/(\text{seconds})^2$, t^2/s^2. Acceptable alternative labelling includes t^2 $(s)^2$, time^2 (s^2), time^2 in s^2.

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(i)	Most points accurately plotted to within 1 mm (no more than one point >± 1 mm) ✓	**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.
(j)	Line of best fit drawn ✓	**1**	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. If the plotted points suggest a curve line, the mark can be awarded for a suitable smooth curve.
	Total	**10**	

Section A		**Mark**	**Additional guidance notes**
1 (a)	Time ✓	**1**	Accept t or t^2
1 (b)	• Mention of human reaction time • Releasing the cylinder and starting the clock • Hand-eye co-ordination when stopping the clock • The slope surface is not uniformly smooth • Takes alternative/different path down ramp Any **two** of above **2 marks max** ✓✓	**2**	
1 (c)	Uncertainty calculated = ±0.5 × spread of t for largest distance value ✓	**1**	No significant figure penalty. No unit penalty.
1 (d)	For graph or t^2 against s: • Statement indicating that graph supports the prediction (Yes prediction is supported by graph) ✓ • Explains/states that straight line with a positive gradient is expected ✓ • The line is expected to pass through the origin ✓	**3**	Credit can be given where a graph of t against s has been plotted. To achieve credit candidates should point out this curve also supports prediction ✓, and will have to use date from curve for other two marks e.g. if s doubles, t^2 quadruples (or similar numerical data from graph) ✓✓ N.B. If a candidate suggests a curved line for a graph of t against s does not support the prediction, this is probably wrong (unless data from graph is used to confirm this).

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1 (e) (i)	Steeper graph means shorter times ✓ % uncertainty in timings would be greater ✓ **OR** Steeper slope might give a greater range ✓, which would increase the uncertainty ✓	**2**	
1 (e) (ii)	Using a longer slope to attain greater speed Using larger cylinder with greater 'effective' area ✓ to create more air resistance enabling effect to be measured ✓ **OR** Use lighter cylinder ✓ because air resistance would have much greater effect ✓	**2**	Also credit: Something to make cylinder move faster because air resistance would be greater / have more effect ✓ (1 mark only)
	Total	**11**	

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Section B		Mark	Additional guidance notes
2 (a)	Distance down the slope ✓	**1**	Accept s Accept same cylinder.
2 (b)	v/m s^{-1}: 2.88, 3.13, 3.33 v^2/m^2 s^{-2}: 8.29, 9.82, 11.07 ✓ sinθ: 0.530, 0.616, 0.707 ✓	**2**	All 6 values correct for 1 mark. Allow 9.80 instead of 9.82. Allow 11.09 or 11.1 instead of 11.07. (Differences due to calculation of squared value after mean value rounded down). 1 mark for all 3 values exactly as stated.
2 (c) (i)	± 0.02 m s^{-1} ✓ (This is 0.5 × spread of repeats)	**1**	Correct answer with unit required. No penalty for incorrect sig figs or missing ±.
2 (c) (ii)	± 0.78 % ✓ (0.02/2.57 × 100 %)	**1**	Mark awarded for numerical answer only. No sig fig penalty and no penalty for missing % or ±. Allow ecf from 2(c)(i).
2 (c) (iii)	± 1.6 % ✓ (double % uncertainty in v. Allow ecf from (c) (ii))	**1**	No penalty for missing % or ±. Answer must be quoted to 1 or 2 significant figures.

2 (d)	Three possible ways of using light gates: <u>Using single light gate at bottom of slope:</u> • timer starts when cylinder enters light gate and stops as cylinder leaves it. ✓ • distance used/timed is diameter of cylinder. ✓ • calculate velocity from distance/time. ✓ **OR** <u>Using two light gates set close together near bottom:</u> • timer starts when cylinder enters 1st light gate and stops when it enters 2nd light gate. ✓ • distance used is distance between light gates. ✓ • velocity calculated by this distance/time recorded. ✓ **OR** <u>Using one light gate at the top and a second at the bottom of the slope:</u> • timer starts when cylinder enters 1st light gate and stops when it enters bottom/2nd light gate. ✓ • distance used is distance between light gates ✓ • velocity calculated by: 2 × distance between gates/time recorded ✓ (This assumes uniformly accelerated motion **from rest**, using $(v + u)/2 = s/t$)	**3**	In general for either method: 1st mark – must be clear what arrangement of light gates starts and stops the timer. 2nd mark – must be clear precisely what distance is measured (Simply stating 'measure distance' is not enough). 3rd mark – for explaining how velocity is calculated from the distance and time measurements recorded. (Simply saying it is worked out on the computer or words to that effect is not acceptable). No need for detailed explanation of calculation but must be clear that velocity = **2** × s/t
2 (e)	All three points correctly plotted. Allow tolerance of ± 1 mm from actual precise position of plot. ✓ Best fit straight line drawn through points. ✓	**2**	Line should be straight line, through origin.
	Total	**11**	

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3 (a)	Triangle drawn with smallest side at least 8 cm ✓ Correct values read from graph ✓ Correct answer for gradient 15.7 ± 0.3 ✓ ($m^2 s^{-2}$) (answer quoted to 2 or 3 sf)	**3**	Ecf from incorrect values recorded from graph only allowed if gradient falls within tolerance stated.
3 (b) (i)	Passes through origin so $c = 0$ ✓	**1**	If line drawn does not pass through origin, candidate must explain that c is not confirmed as zero to achieve this mark.
3 (b) (ii)	Gradient = $\frac{4gs}{3}$ ✓	**1**	
3 (b) (iii)	$s = 1.20 \pm 0.05$ m (answer quoted to 2 or 3 sf) ✓ Allow ecf from gradient value	**1**	Answer **must** include the unit for the mark.
	Total	**6**	

4	Possible marking points: • release from rest • roll same distance for both cylinders • time each cylinder • hollow time would need to be greater if student prediction is correct • discussion of technique to reduce uncertainty (e.g. use longer slope for larger times) **3 marks max** ✓✓✓	**3**	
	Total	**3**	
	Total	**31**	