Cambridge International AS & A Level

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PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **March 2018**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks
1(a)	Value of L_0 in the range 59 cm to 61 cm, with unit.	**1**
1(b)	Value of L less than L_0	**1**
1(c)	Six sets of readings of n and L (with the correct trend and without help from supervisor) scores 5 marks, five sets scores 4 marks etc.	**5**
	Range of values: Values of n must include at least 2 and 8.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. $1 / L / \text{cm}^{-1}$.	**1**
	Consistency: Values of raw L must all be given to the nearest mm.	**1**
	Significant figures: Significant figures for every value of $1 / L$ same as, or one greater than, the s.f. of L as recorded in table.	**1**
	Calculation: Correct calculation of $1 / L$ with no rounding error.	**1**

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Question	Answer	Marks
1(d)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10). Scales must be chosen so that the plotted points occupy at least half the graph grid in both *x* and *y* directions Scales must be labelled with the quantity which is being plotted. Scale markings should be no more than 3 large squares apart.	**1**
	Plotting of points: All observations must be plotted on the grid. Diameter of plotted points must be ⩽ half a small square (no blobs). Plots must be accurate to within half a small square in both *x* and *y* directions.	**1**
	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. Scatter of points must be no more than $\pm 0.005\ \text{cm}^{-1}$ ($\pm 0.5\ \text{m}^{-1}$) from a straight line in the $1 / L$ direction.	**1**
1(d)(ii)	Line of best fit: Judged by balance of all points on the grid (at least 5) about the candidate's line. There must be an even distribution of points either side of the line along the full length. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a small square.	**1**
1(d)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Method of calculation must be correct. Both read-offs must be accurate to half a small square in both the *x* and *y* directions.	**1**
	y-intercept: **Either** Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression, with read-off accurate to half a small square in both *x* and *y* directions. **Or** Intercept read directly from the graph, with read-off at $1 / n$ = zero accurate to half a small square in *y* direction.	**1**

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Question	Answer	Marks
1(e)	Value of a equal to candidate's gradient. Value of b equal to candidate's intercept.	**1**
	Unit for a and unit for b are dimensionally correct (e.g. $a = 16.9\ m^{-1}$ and $b = 1.7\ m^{-1}$)	**1**

Question	Answer	Marks
2(a)	Values for d_A and d_B, with unit, both <1 mm	**1**
	Raw values for d_A and d_B recorded to nearest 0.01 mm.	**1**
2(b)	Value for W_B, with unit, >2 mm	**1**
2(c)	Absolute uncertainty in W_B value of 0.2 cm to 0.5 cm and correct method of calculation to obtain percentage uncertainty. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero if values are equal).	**1**
2(d)	Value for W_A.	**1**
	Evidence of several raw measurements used to find the average, either here or in **2(b)**.	**1**
2(e)	Value for second W_B.	**1**
	Quality: Second W_B greater than first W_B.	**1**
	Value for second W_A.	**1**
2(f)(i)	Two values of k calculated correctly.	**1**
2(f)(ii)	Justification based on s.f. in d_A, d_B, W_B and W_A.	**1**
2(f)(iii)	Sensible comment relating to the calculated values of k, testing against a criterion specified by the candidate.	**1**

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Question	Answer	Marks
2(g)(i)	Two *k* values are not enough to draw a valid conclusion	**4 max**
	Difficult to: place glass plate / remove (B) wires / press down, without moving A wires	
	(Water drop) irregular shape so difficult to find average width	
	Parallax when measuring water drop	
	Graph grid is 2 mm (or just 'grid is large') / large % uncertainty in *w*	
	Outline of drop not clear because colourless / drop is colourless so difficult to see edge / drop is colourless so difficult to see width	
	Force not constant	
2(g)(ii)	Take more readings and plot a graph / calculate more *k* values and compare	**4 max**
	Tape / clamp / weight / stick the wires	
	Measure with ruler / calipers	
	Grid marked on glass / place drop on waterproof graph paper	
	Use smaller (or 1 mm) grid / use large drops to reduce uncertainty	
	Use coloured water	
	Use masses / small load / other defined workable method of producing consistent force	

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