Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2019**

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.

Cambridge International will not enter into discussions about these mark schemes.

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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)(i)	Value of x in range 17.0–23.0 cm.	**1**
1(a)(ii)	Value of L to nearest mm.	**1**
1(b)	Value of L greater than value in **(a)(ii)**.	**1**
1(c)	Six sets of readings of x and L with correct trend and without help from the Supervisor scores four marks, five sets scores three marks, etc.	**4**
	Range: $x_{min} \leqslant 10.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity and a unit. The presentation of quantity and unit must conform to accepted scientific convention, e.g. x^2 / cm^2.	**1**
	Consistency: All values of x and L must be given to the nearest mm.	**1**
	Significant figures: Number of significant figures for every value of x^2 same as, or one greater than, the number of s.f. of raw x as recorded in table.	**1**
	Calculation: Values of x^2 calculated correctly.	**1**

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Question	Answer	Marks
1(d)(i)	Axes: Sensible scales must be used (no awkward scales, e.g. 3:10 or fractions). 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 that is being plotted. Scale markings should be no more than three large squares apart.	**1**
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be $\leqslant$ half a small square. Points 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 five). Scatter of plots must be no more than ±1 cm (to scale) from a straight line in the *L* direction. Trend of points on graph must be negative.	**1**
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid (at least five) 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. There must be at least five points left after disregarding the anomalous point. Line 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, e.g. not Δx / Δy. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. Sign of gradient on answer line must match graph drawn.	**1**
	y-intercept: Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression. Read-off must be accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph, with read-off at $x = 0$ accurate to half a small square in *y* direction.	**1**

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Question	Answer	Marks
1(e)	*a* equal to candidate's gradient **and** *b* equal to candidate's intercept. The values must not be fractions.	**1**
	Unit for *a* is correct (e.g. cm^{-1}) **and** unit for *b* is correct (e.g. cm).	**1**

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Question	Answer	Marks
2(a)	Value for h_0 to nearest mm and in range 20–200 mm.	**1**
2(b)(i)	Value for I in range 0.20–0.70 A and obtained without help from the Supervisor.	**1**
	Value for V in range 0.5–3.5 V.	**1**
2(b)(ii)	Value for $h < h_0$.	**1**
2(b)(iii)	Correct calculation of Δh.	**1**
2(c)	Percentage uncertainty based on an absolute uncertainty in Δh value of 1 or 2 mm. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(d)	Correct calculation of T and value given to nearest K.	**1**
2(e)	Second values of I, V and h.	**1**
	Quality: Second Δh greater than first Δh.	**1**
2(f)(i)	Two values of β calculated correctly.	**1**
2(f)(ii)	Justification based on significant figures in I, V and $T^4 - T_0^4$.	**1**
2(f)(iii)	Valid comment relating to the calculated values of β, testing against a criterion specified by the candidate.	**1**

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Question	Answer	Marks
2(g)(i)	A Too few readings/(only) two readings not enough to draw a (valid) conclusion (**not** 'not enough for accurate results', 'few readings'). B Difficulty measuring h/h_0/height because rule not vertical/not steady. C Large percentage uncertainty in Δh/large uncertainty in Δh because Δh small. D T_0 may vary from stated value (during the experiment). E Meter readings fluctuate. F Expansion may be permanent/doesn't return to h_0. *1 mark for each point up to a maximum of 4.*	**4**
2(g)(ii)	A Take more readings and plot a graph or take more readings and compare β values (**not** 'repeat readings' on its own). B Hold rule (vertically) in clamp. C1 Use longer wooden strip/attach wire closer to pivot. C2 Use larger current/voltage. C3 Use vernier calipers/digital calipers/travelling microscope. D Use a thermometer to measure T_0 at the time the h readings are taken/during experiment. E Clean crocodile clips/contacts with method. F Re-measure h_0 between tests. *1 mark for each point up to a maximum of 4.*	**4**

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