Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/32**

Paper 3 Advanced Practical Skills 2 **May/June 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)(i)	Value of h to nearest mm, with unit.	**1**
1(a)(ii)	Value of t in the range 1.0–5.0 s, with unit.	**1**
	At least two readings of t.	**1**
1(b)	Six sets of readings of h and t showing the correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range: $t_{max} \geqslant 2.0$ s and $t_{min} \leqslant 1.5$ s.	**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. $(1 / t^2) / s^{-2}$.	**1**
	Consistency: All raw values of t must be given to 0.01 s or all must be given to 0.1 s.	**1**
	Significant figures: Significant figures for every value of $1/t^2$ same as, or one greater than, the number of s.f. of t as recorded in table.	**1**
	Calculation: Values of $1/t^2$ calculated correctly to the number of s.f. given by the candidate.	**1**

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Question	Answer	Marks
1(c)(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 ⩽ 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 $\pm$ 0.05 s^{-2} from a straight line in the $1/t^2$ direction.	**1**
1(c)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5). There must be an even distribution of points either side of the line along the full length. Allow one anomalous 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(c)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. The method of calculation must be correct. Do not allow $\Delta x / \Delta y$. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. Sign of gradient must match graph.	**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**
1(d)	Value of *a* equal to candidate's gradient **and** value of *b* equal to candidate's intercept.	**1**
	Unit for *a* correct (e.g. $mm^{-1} s^{-2}$ or $cm^{-1} s^{-2}$) **and** unit for *b* is s^{-2}.	**1**

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Question	Answer	Marks
2(a)	Value for L to nearest mm with unit and in range 50.0–75.0 cm.	**1**
2(b)	Value for x with unit.	**1**
	Raw value(s) of x to nearest mm and value on answer line in range 100–200 mm.	**1**
2(c)	Absolute uncertainty in x value of 0.2–0.5 cm and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the absolute uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(d)	Correct calculation of λ to the number of significant figures used by the candidate.	**1**
2(e)	Justification linking s.f. in λ to s.f. in L.	**1**
2(f)	Correct calculation of f.	**1**
2(g)	Second values of L and x.	**1**
	Quality: x increases as μ increases.	**1**
	Second values of λ and f.	**1**
2(h)(i)	Two values of k calculated correctly.	**1**
2(h)(ii)	Valid comment consistent with the calculated values of k, testing against a numerical criterion specified by the candidate.	**1**

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Question	Answer	Marks
2(i)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to see string pattern. C String pattern dies away quickly. D Difficult to produce exact pattern required. E Difficulty with wooden block e.g. doesn't grip blade/hard to hold down block and oscillate blade/view pattern at same time. F Hacksaw/mass not at a node in the string pattern. *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take many readings and plot a graph or take more values of *k* and compare (**not** "repeat readings" on its own). B Put contrasting/black/white background behind string. C Use photo/video to assess pattern or description of workable method of producing continuous oscillations. D Add a scale/marks to hacksaw blade. E Clamp/put weight on the movable wooden block. F Workable solution to allow a node e.g. move excitation point away from node/use heavier mass. *1 mark for each point up to a maximum of 4.*	**4**

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