Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 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)	Value of x in the range 18.0–22.0 cm with unit.	**1**
1(b)	Value of T in the range 2.50–4.50 s with unit.	**1**
	Evidence of at least two readings of nT where $n \geqslant 2$.	**1**
1(c)	Five sets of readings of x and T (different values) showing the correct trend and without help from the Supervisor scores 4 marks, four sets scores 3 marks etc.	**4**
	Range: $x_{min} \leqslant 5.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity, a unit and a separating mark where appropriate. The presentation of the quantity and unit must conform to accepted scientific convention e.g. x / m.	**1**
	Consistency: All raw values of x must be given to the nearest mm only.	**1**
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 correctly 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 (no “blobs”). Points must be plotted to an accuracy of half a small square.	**1**
	Quality: All observations in the table (at least 4) must be plotted on the grid. Trend of points on graph must be correct. It must be possible to draw a straight line that is within ±2.0 cm (to scale) of all the plotted points on the x-axis.	**1**

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Question	Answer	Marks
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 4 points). There must be an even distribution of points either side of the line along the full length. If there are 5 or more points, allow one anomalous point only if clearly indicated 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. 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 and substituted into $y = mx + c$. 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.	**1**
1(e)	Value of P = candidate's gradient **and** value of Q = candidate's intercept. The values must not be fractions.	**1**
	Units for P (s m^{-1}, s cm^{-1} or s mm^{-1}) and Q (s) correct.	**1**
1(f)	Correct calculation of x [= $(T - Q) / P$] from values of T, P and Q and consistent sign.	**1**
	Final answer for x given to three significant figures.	**1**

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Question	Answer	Marks
2(a)(i)	Raw values of θ to the nearest degree and $\theta < 90°$.	**1**
2(a)(ii)	Correct calculation of $(\sin 2\theta)(\cos 2\theta)$.	**1**
2(a)(iii)	Justification for s.f. in $(\sin 2\theta)(\cos 2\theta)$ linked to s.f. in θ or angle.	**1**
2(b)	Value of d to the nearest mm with unit.	**1**
	Value of d in the range 35.0 cm < d < 45.0 cm.	**1**
2(c)(i)	Value of h with unit in the range 10.0 cm < h < 100.0 cm.	**1**
2(c)(ii)	Percentage uncertainty in h based on absolute uncertainty of 0.5–5.0 cm. 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)	Second values of θ and d.	**1**
	Second value of h.	**1**
	Quality: Second value of h greater than first value of h.	**1**
2(e)(i)	Two values of k calculated correctly.	**1**
2(e)(ii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**

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Question	Answer	Marks
2(f)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to set θ (or angle) with a reason e.g. board moves/is tilted or moves when clamp tightened. C Difficult to locate A or B because difficult to judge the horizontal. D Difficult to measure *d* with reason e.g. parallax error, moving card, ruler held by hand, card not perpendicular to bench, card not vertical. E Difficult to release/align the ball either directly above the dot or without applying a force or in exactly the same place when repeated. F Difficult to find/measure *h* with a reason e.g. parallax error, ruler held by hand, ball held by hand, ruler not vertical, uneven bounce of ball. G Difficult to judge whether the ball hits the line or A or B. *1 mark for each point up to a maximum of 4.*	**4**

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Question	Answer	Marks
2(f)(ii)	A Take more readings <u>and</u> plot a graph or take more readings <u>and</u> compare *k* values (**not** "repeat readings" on its own). B Improved method to make ramp more stable or θ easy to adjust e.g. use two stands, use pile of books (that can be moved), lab jack. C Improved method of locating A or B e.g. detailed use of spirit level/set squares/ruler(s). D Improved method of measuring *d* e.g. clamp a ruler horizontally or to measure *d*, trigonometry with detail, clamp top of card, use stiffer or thicker card. E Improved method of aligning or releasing ball e.g. launch guide, plumb line, short tube (with card), clamp guide vertically, method of fixing release point, hang ball by string and cut/burn. F Improved method to find *h* e.g. clamp ruler vertically or to measure *h* (allow use of set square on bench and ruler (with detail)). G Improved method of judging where the ball hits the card e.g. paint ball, coloured screen, sticky screen or video/film (and replay) linked to ball hitting card. *1 mark for each point up to a maximum of 4.*	**4**

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