Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 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.

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)	Answer line value of $0.5\,\text{cm} \leqslant x_0 \leqslant 2.5\,\text{cm}$ with unit.	**1**
1(b)	Value of raw θ to the nearest degree with unit **and** answer line value of $\theta < 90°$.	**1**
1(c)	Six sets of readings of x and θ (different values) with the correct trend and without help from Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values of θ must include one value greater than and one value less than the value of θ in **(b)**.	**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. x/cm, e/cm, $e/\cos\theta$ (m), θ/°, $\tan\theta$ without a unit.	**1**
	Consistency: All raw values of x must be given to the nearest mm only.	**1**
	Significant figures: All values of $e/\cos\theta$ must be given to the same number of significant figures as (or one more than) the number of significant figures in e or θ, whichever is the smaller.	**1**
	Calculation: Values of $e/\cos\theta$ are correct.	**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 plotted to an accuracy of half a small square.	**1**
	Quality: Trend of points on graph must be negative. All points in the table (at least 5) must be plotted on the grid. It must be possible to draw a straight line that is within ± 0.05 (to scale) on the $\tan\theta$ axis (normally *x*-axis) of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length. Allow one anomalous point only if clearly indicated (i.e. circled or labelled). There must be at least 5 points left after the anomalous point is disregarded. 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 on answer line must match graph.	**1**
	y-intercept: Correct read-off from a point on the line 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 $\tan\theta = 0$, accurate to half a small square.	**1**

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Question	Answer	Marks
1(e)	Value of N = candidate's gradient **and** value of M = candidate's intercept. The values must not be fractions.	**1**
	Units for N **and** M correct (e.g. m or cm or mm).	**1**

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Question	Answer	Marks
2(a)(i)	All values of raw d to the nearest 0.01 mm and answer line value of d in the range 0.50 mm $\leqslant d \leqslant$ 5.00 mm.	**1**
	Evidence of repeats.	**1**
2(a)(ii)	Absolute uncertainty in d in the range 0.02–0.2 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(a)(iii)	Correct calculation of A with correct unit.	**1**
2(a)(iv)	Justification for significant figures in A linked to significant figures in d.	**1**
2(b)(i)	Value of p.	**1**
2(b)(ii)	Correct calculation of $(p + q)/2$.	**1**
2(c)	Second value of d.	**1**
	Second values of p and q.	**1**
	Quality: Second value of $(p + q)/2$ less than first value of $(p + q)/2$.	**1**
2(d)(i)	Two values of k calculated correctly.	**1**
2(d)(ii)	Valid comment consistent with the calculated values of k, testing against a criterion stated by the candidate.	**1**

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Question	Answer	Marks
2(e)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficulty with measuring *d* with a reason e.g. string is soft/string is compressed (by micrometer)/diameter not uniform along length. C Difficulty linked to placing paper clips on hanger with a reason e.g. clips slide off/added force from hand/dropping clips starts movement/difficult not to touch hanger when releasing clips/hanger too small for clips. D Idea of increments being too large e.g. large increments of mass (large uncertainty in the value of *p* or *q*) **or** only a small number of clips are added **or** exact force needed to cause movement may not equal a whole number of clips **or** mass of each paper clip is too large E Mass of clips may be different **or** two strings are of different material *1 mark for each point up to a maximum of 4.*	**4**
2(e)(ii)	A Take more readings (for different values of *d*) and plot a graph **or** take more readings and compare *k* values (not "repeat readings" on its own). B Workable improved method e.g. wrap string round a rod and measure many *d*/use travelling microscope. C Workable method of adding or holding paper clips e.g. add a hook to each mass hanger/use a wider mass hanger or tweezers. D Improved method of loading e.g. use smaller clips/lighter clips/smaller masses to add to mass hanger **or** use of sand/water with detail. E Method to check clips have the same mass e.g. use a balance. *1 mark for each point up to a maximum of 4.*	**4**

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