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 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.

Cambridge International is publishing the mark schemes for the October/November 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

Cambridge Assessment International Education

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.

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.

Question	Answer	Marks
1(a)	Value of T on the answer line in the range 1.0–2.0 s with unit.	1
1(b)	Six sets of readings of n and T (different values) with the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: n values include n = 2 or less **and** n = 13 or more.	1
	Column headings: Each column heading must contain a quantity, a unit where appropriate and a separating mark. The presentation of quantity and unit must conform to accepted scientific convention e.g. T / s, T^2 / s^2 and n has no unit.	1
	Consistency: Raw values of time must <u>all</u> be given to the nearest 0.1 s or <u>all</u> to the nearest 0.01 s.	1
	Significant figures: All values of T^2 must be given to the same number of s.f. as (or one more than) the number of s.f. in raw time values.	1
	Calculation: Correct calculation of T^2.	1
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 must 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: All points in the table (at least 5) must be plotted on the grid. Trend of points on graph must be negative. It must be possible to draw a straight line that is within ±1 (to scale) on the n-axis of <u>all</u> plotted points.	1

Question	Answer	Marks
1(c)(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. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. 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(c)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. The method of calculation must be correct e.g. not $\Delta x / \Delta y$. The sign of the gradient on the answer line must match the 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 $n = 0$ accurate to half a small square.	**1**
1(d)	Value of *P* = candidate's gradient **and** value of *Q* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *P* is s^2 **and** unit for *Q* is s^2.	**1**
1(e)	Line *W* is drawn with the same gradient and a larger *y*-intercept.	**1**

Question	Answer	Marks
2(a)(i)	Value(s) of <u>raw</u> α to the nearest degree and final value < 90°.	**1**
	Evidence of repeated α.	**1**
2(a)(ii)	Percentage uncertainty based on an absolute uncertainty in α in the range 2–5°. 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(b)	Value(s) of raw x to the nearest mm with unit.	**1**
2(c)	Value of $\beta > \alpha$.	**1**
2(d)(i)	Correct calculation of $(x + y)^2$.	**1**
2(d)(ii)	Justification for s.f. in $(x + y)^2$ linked to s.f. in $(x + y)$.	**1**
2(e)	Second value of x.	**1**
	Second value of β.	**1**
	Quality: second value of β greater than α **and** second value of β < first value of β.	**1**
2(f)(i)	Two values of k calculated correctly.	**1**
2(f)(ii)	Valid comment consistent with the calculated values of k, testing against a criterion stated by the candidate.	**1**

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 in measuring angle(s) or α or β with a reason e.g. difficult to hold board or protractor steady/board or protractor held by hand/difficult to hold board and protractor at same time. C Difficulty with raising the board e.g. difficult to raise board evenly/jerks/suddenly rises and consequently board shakes causing magnet to move/difficult to change the angle by small increments (idea of sensitivity). D Base of board slides/slips along bench. E Magnet crashes into bench (and could affect strength of magnet). F Difficulty with board surface e.g. surface may not be uniformly smooth/may be uneven. *1 mark for each point up to a maximum of 4.*	**4**
2(g)(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 of supporting protractor or board e.g. clamp protractor/clamp board **or** Detailed method of using trigonometry e.g. measure elevation (*o*) and length of board (*a*) calculate sin angle = *o* / *a* **or** Film/video/record with protractor in view. C Method described to increase the angle in smaller increments e.g. lab jack support/string attached to board and a pulley with handle. D Method of fixing base of board e.g. adhesive putty/heavy block. E Improved method to protect magnets e.g. place foam around bench/wooden barrier. F Method to provide a smooth surface e.g. named smooth material e.g. glass **or** valid method e.g. sand board. *1 mark for each point up to a maximum of 4.*	**4**