Cambridge International AS & A Level

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PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **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.

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 raw d to nearest mm with unit and in the range 29.0–31.0 cm.	**1**
1(b)	Value of T in the range 0.8–2.0 s with unit **and** evidence of at least two sets of nT where $n \geqslant 5$.	**1**
1(c)	Second set of values of s and T.	**1**
1(d)	Five sets of readings of s and time (different values) with the correct trend and without help from the Supervisor scores 4 marks, four sets scores 3 marks etc.	**4**
	Range: at least one value of $s \leqslant 70.0$ cm **and** at least one value of $s \geqslant 85.0$ cm	**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. s/cm, T/s, T^2/s^2 or T^2 (s^2).	**1**
	Consistency: All raw time values must be given to 0.1 s or all given to 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 the raw value(s) of time. If raw times are given to 0.01 s, allow T^2 to be recorded to 1 s.f. less than the raw times.	**1**
	Calculation: Values of T^2 are correct.	**1**

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Question	Answer	Marks
1(e)(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 (no "blobs"). Points must be plotted to an accuracy of half a small square.	**1**
	Quality: All points in the table must be plotted on the grid for this mark to be awarded. It must be possible to draw a straight line that is within $\pm$ 2.5 cm (to scale) on the *s* axis (normally *x* axis) of all plotted points.	**1**
1(e)(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. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least four points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a small square.	**1**
1(e)(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 correctly 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 $s = 0$, accurate to half a small square in *y* direction.	**1**

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Question	Answer	Marks
1(f)	Value of P = candidate's gradient **and** value of Q = candidate's intercept. The values must not be fractions.	**1**
	Unit for P correct (e.g. s^2m^{-1} or s^2cm^{-1} or s^2mm^{-1}). **and** Unit for Q is s^2.	**1**

Question	Answer	Marks
2(a)	Value of x with unit and in the range 1.0–5.0 mm.	**1**
2(b)	All value(s) of raw y to nearest mm with unit.	**1**
	Evidence of repeat values of y.	**1**
2(c)	Absolute uncertainty in y in the range 2–4 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 find percentage uncertainty.	**1**
2(d)	Second value of x.	**1**
	Second value of y.	**1**
	Quality: second value of y < first value of y.	**1**
2(e)(i)	Two values of k calculated correctly.	**1**
2(e)(ii)	Valid comment consistent with the calculated values of k, testing against a criterion stated by the candidate.	**1**
2(f)(i)	Value of y.	**1**
2(f)(ii)	Correct calculation of x.	**1**
2(f)(iii)	Justification for s.f. in x linked to s.f. in y.	**1**

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2(g)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficulty with alignment at A with a reason e.g. string twists/magnet will not settle/magnet continually moves/draughts or air conditioning disturb magnet. C Difficulty with finding position C or position after 30 oscillations or finding *y* with a reason e.g. magnet only stays at position C for a short time/difficult to estimate where magnet will stop/difficult to judge the end of an oscillation/parallax. D Difficulty linked to *x* with a reason e.g. metre rule (too large or not precise enough/large <u>percentage</u> uncertainty in *x*/value of *x* is small/ adjustment difficult or clumsy with clamp and cork/angled lower surface of magnet. E Difficulty with the oscillation e.g. magnet rotates while swinging/wrong mode of oscillation/magnetic stand attracts the magnet affecting its motion. *1 mark for each point up to a maximum of 4.*	**4**
2(g)(ii)	A Take many 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 alignment with A e.g. valid improvement to suspension e.g. nylon thread/wire/double point of suspension/switch off AC/windshield. C Improved method of locating C e.g. use a scale/use of a pointer with detail of how pointer is used e.g. attached to magnet/use to refine position of C. D1 Improved method to adjust *x* e.g. scissor jack/rearrange suspension to use screw thread on clamp. D2 Improved method to measure *x* e.g. travelling microscope/vernier or digital calipers/use of thin spacers e.g. sheets of paper/shim. E Use a wooden or plastic stand i.e. a named non-magnetic material. *1 mark for each point up to a maximum of 4.*	**4**

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