Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/31**

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 raw *v* to nearest mm, with final value in the range 3.0–7.0 cm with a unit.	**1**
1(b)	Value of $x < y$.	**1**
1(c)	Six sets of readings of *x* and *y* (different values) with the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values include one (average) *x* value above 50.0 cm **and** one (average) *x* value below 50.0 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* / cm.	**1**
	Consistency: All raw values of *x* and *y* must be given to the nearest mm only.	**1**
1(d)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 15 small squares for 10 units 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. 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) on the y-axis (y / cm axis) of all plotted points.	**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 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) by the candidate. There must be at least five 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 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**
	No unit for P **and** unit for Q correct e.g. mm or cm or m.	**1**
1(f)	Correct calculation of R.	**1**
	Value of R on the answer line given to 3 significant figures.	**1**

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Question	Answer	Marks
2(a)(i)	Value(s) of raw *d* and raw *t* to nearest mm with units.	**1**
2(a)(ii)	Percentage uncertainty in *d* based on an absolute uncertainty in the range 2–5 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(b)(i)	Correct calculation of *V*.	**1**
2(b)(ii)	Justification for s.f. in *V* linked to s.f. in *d* and *t*.	**1**
2(c)	Value of *n*.	**1**
	Evidence of repeated *n*.	**1**
2(d)	Second values of *d* and *t*.	**1**
	Second value of *n*.	**1**
	Quality: Second value of *n* less than first value of *n*.	**1**
2(e)(i)	Two values of *k* calculated correctly. The final *k* values must not be fractions.	**1**
2(e)(ii)	Valid comment consistent with calculated values of *k*, testing against a criterion stated by the candidate.	**1**
2(f)	Correct unit and calculation of *M* using second *k*, and in the range 1.0–10.0 g.	**1**

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Question	Answer	Marks
2(g)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Lid tilts/sinks more quickly with a reason e.g. cannot stack in one place/tendency to drop coins heavily/force added by hand. C Lid has a curved edge leading to inaccurate *d*/*t*/*V*. D Parallax error in *t*. E Large percentage uncertainty in *t* as *t* is small. F Mass of lid needs to be known/masses of two lids are different. G Coins have different mass **or** Coins or lid heavier when readings repeated because they are wet. *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 loading coins e.g. tweezers/tongs/forceps/guide for coins mounted centrally. C Improved method of finding *V* e.g. displacement method/filling with liquid using syringe or pipette. DE Improved method of measuring *t* e.g. (vernier/digital) calipers/travelling microscope/two blocks/use many stacked lids of the same type. F Method to measure mass e.g. balance/scales. G Method to ensure coins or lid are dry e.g. allow water to evaporate/use hair dryer/use fresh coins or lid each time. *1 mark for each point up to a maximum of 4.*	**4**

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