Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/32**

Paper 3 Advanced Practical Skills 2 **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.

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).

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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 range 45.0–55.0 cm.	**1**
1(b)	Value of $y < x$.	**1**
1(c)	Six sets of readings of x and y with the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $x_{min} \leq 20.0$ cm **and** $x_{max} \geq 80.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity, a unit and a separating mark where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. $1 / x / \text{cm}^{-1}$.	**1**
	Consistency: All values of x and y must be given to the nearest mm.	**1**
	Significant figures: The number of significant figures for every value of $1 / y$ should be the same as, or one greater than, the number of s.f. of y as recorded in the table.	**1**
	Calculation: Values of $1 / y$ calculated correctly.	**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 ≤ half a small square (no blobs). Plots must be accurate to within half a small square in both *x* and *y* directions.	**1**
	Quality: All observations in the table (at least 5) 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 ±0.005 cm^{-1} (±0.5 m^{-1}) in the 1 / *x* direction of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid (at least 5) about the candidate's line. 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. Lines must not be kinked or thicker than half a 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**

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Question	Answer	Marks
1(e)	*a* equal to candidate's gradient **and** *b* equal to candidate's intercept. The values must not be fractions.	**1**
	No unit for *a* **and** unit for *b* is correct (e.g. m^{-1}).	**1**

Question	Answer	Marks
2(a)	Value for θ recorded to nearest degree and $\theta < 90°$.	**1**
2(b)	Value for *F* recorded to nearest 0.1 N with unit.	**1**
	Evidence of repeat readings of *F*.	**1**
2(c)	Percentage uncertainty in *F* based on an absolute uncertainty of 0.2–0.5 N. 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)(i)	Second value for θ.	**1**
2(d)(ii)	Second value for *F*.	**1**
	Quality: Second *F* < first *F*.	**1**
2(e)	Value of *W* in range 1.0–5.0 N with unit.	**1**
2(f)(i)	Two values of μ calculated correctly.	**1**
2(f)(ii)	Valid comment consistent with the calculated values of μ, testing against a criterion specified by the candidate.	**1**
2(g)	Correct calculation of *F*.	**1**
	F given to 2 or 3 significant figures.	**1**

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Question	Answer	Marks
2(h)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to clamp board so that it is stable. C Difficult to pull (block) at steady speed. D Difficulty with *F*/force/newton-meter reading with reason (e.g. fluctuates / friction varies in different places). E *F* is small so percentage uncertainty in *F* is large. *1 mark for each point up to a maximum of 4.*	**4**
2(h)(ii)	A Take more readings and plot a graph or take more readings and compare μ values (**not** "repeat readings" on its own). B Improved clamping method e.g. use two clamps/fix base to bench with adhesive putty. C Detail of constant speed pulling arrangement (e.g. use motor/pulley with mass adjusted to give terminal velocity). D Video/film/record linked to measurement of force. E Use force sensor with data logger/use more precise newton-meter/add masses on top of block. *1 mark for each point up to a maximum of 4.*	**4**

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