UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9702 PHYSICS

9702/33 Paper 31 (Advanced Practical Skills 1), maximum raw mark 40

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.

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1 (a) (ii) Value of raw h to the nearest mm (unit needed). $h > 20$ cm. [1]

(b) Evidence of repeat times: of one swing repeated several times or the time for a number of swings recorded at least once (not fixed time and count n). [1]
Value of $0.5 < T < 3$ s.

(c) Six sets of readings of x and T scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect or no trend then –1 (Correct trend x increases, T^2 decreases). SH –1.
Write a ringed total next to the table.

Maximum value of x at least $h/2$. [1]

Column headings (x / m, x / mm, T / s, T^2/s^2). [1]
Must have x and T^2 columns.
Each column heading must contain a quantity and a unit.
Ignore any units in the body of the table.
There must be some distinguishing mark between the quantity and the unit (solidus is expected but accept, for example, x (m)).

Consistency of presentation of raw readings. [1]
All values of raw x must be given to the nearest mm and all values of raw time to the same number of d.p. (either 1 or 2).

Significant figures. [1]
Significant figures for T^2 must be the same as, or one more than, the least number of significant figures used in the raw time data. Also if raw time is given to the nearest hundredth of a second accept one less significant figure in T^2.

Correct calculation of T^2. Do not allow t^2. [1]

(d) (i) Axes: [1]
Sensible scales must be used. No awkward scales (e.g. 3:10).
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 which is being plotted. Ignore units.
Scale markings should be no more than three large squares apart.

All observations must be plotted on the grid. [1]
Write a ringed total of plotted points.
Ring and check a suspect plot.
Work to an accuracy of half a small square.
Do not accept blobs (points with diameter > 0.5 small square).

(ii) Line of best fit. [1]
Judge by balance of at least 5 points about the candidate's line.
There must be an even distribution of points either side of the line along the full length.
Line must not be kinked. Do not allow lines thicker than half a small square.

Quality. [1]
Scatter of points must be less than ± 1 cm (to scale) in the *x* (cm) direction of a straight line. All points in table must be plotted (at least 5) for this mark to be awarded.

(iii) Gradient. [1]
Negative sign must be seen on answer line consistent with graph.
The hypotenuse of the triangle must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square.

Intercept. [1]
Either:
Check correct read-off from a point on the line and substitution into $y = mx + c$.
Read off must be accurate to half a small square. Allow ecf of gradient value.
Or:
Check read-off of intercept directly from the graph.

(e) Value of $\frac{A}{B} = \frac{y - \text{intercept}}{|-\text{gradient}|}$ (Expect value to be approximately equal to *h*). [1]

Unit for *A*/*B* correct (e.g. m) consistent with value. [1]
Allow candidate's value $0.5\,h < A/B < 1.5\,h$.

[Total: 20]

2 Measurement of d_A in range 0.20 mm < d_A < 0.40 mm to nearest 0.01 mm or 0.001 mm with consistent unit. If OOR allow SV ± 0.10 mm. [1]

Evidence of repeated measurements of d (or in (e)). [1]

(c) (i) Measurement of L to nearest mm with consistent unit. [1]

(ii) Absolute uncertainty in L is 2 mm–10 mm. [1]
If repeated readings have been taken, then the uncertainty can be half the range.
Correct method of calculation to get percentage uncertainty. [1]

(d) (ii) Measurement of V_A. Any supervisor's help –1. [1]

(e) Value of d_B. Major help from supervisor –1. [1]

(f) (ii) Measurement of V_B to at least nearest 0.1 V with unit. V < 2 V. If > 2 V check SV. [1]

Quality: $V_B < V_A$. [1]

(g) (i) Values of k calculated correctly. [1]

(ii) Justification of sf in k linked to L and d and V. [1]

(iii) Valid conclusion based on the calculated values of k. [1]
Candidate must test against a stated criterion.

(h)

(i) Limitations [4]		**(ii)** Improvements [4]		Do not credit
A_p	Two readings are not enough (to draw a conclusion.	A_s	Take more readings <u>and</u> plot a graph/calculate more values of k.	One reading/ few readings/ take more readings and average.
B_p	Difficult to measure length because (give a reason) e.g. clips have a width/ clip slips. Difficult to make *L* the same (for both experiments).	B_s	Use sliding jockeys/narrower clips/ solder contacts/use longer wire (to reduce % error).	
C_p	Voltmeter scale not sensitive enough/not precise enough/only reads to 0.1 or 0.05 V.	C_s	Use digital voltmeter/use a voltmeter that reads to 0.01 V.	Voltmeter not accurate enough. More accurate voltmeter.
D_p	Wires kinked/Wires not straight/Difficult to keep wire straight/difficult to prevent short circuiting.	D_s	Method of keeping wire (during experiment) straight e.g. tape to ruler, hang weights off end, clamp wire.	Parallax error.
E_p	Difficult to make I the same (for both experiments).	E_s	Method to obtain continuous variation in the current e.g. (slide wire) potentiometer/potential divider/finer wire rheostat/longer rheostat.	
F_p	Contact resistance/ fluctuating ammeter or voltmeter readings.	F_s	Method of cleaning contacts e.g. sand clips. Tighten clips.	

Ignore reference to parallax error, zero error on meters, heating effects of wire, cell runs down, video the experiment.

[Total: 20]