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

9702/31 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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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1 (a) (i) No help from Supervisor. [1]

(ii) Values of *a* and *b* with consistent units to the nearest mm. [1]

(b) Six sets of readings of *a*, *b* and *R* scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend then –1. Correct trend *b*/*a* increases, *R* increases.
Major help from supervisor –1.

Range: used *R* = 8000 Ω or 7000 Ω. [1]

Column headings (*R*/Ω, *a*/m, *b*/m, *b*/*a*). [1]
Must have *R* and either *b*/*a* or *a* and *b* columns.
Each column heading must contain a quantity and a unit where appropriate.
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, *R* (Ω).

Consistency of presentation of readings. [1]
All values of raw *a* and *b* must be given to the nearest mm.

Significant figures. [1]
Significant figures for *b*/*a* must be the same as, or one more than, the least number of s.f. used in *a* or *b*.

Correct calculation of *b*/*a*. [1]

(c) (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. Ignore any plot off the grid. [1]
Write a ringed total of plotted points.
Ring and check a suspect point.
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 trend points about 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 ± 200 Ω in the *R* – axis about a straight line.
All points in the table must be plotted (at least 5) for this mark to be awarded.

(iii) Gradient. [1]
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.

(d) Gradient = $\frac{1}{X}$ [1]

Value of X in range 3000–3600 Ω with unit.

(e) $\frac{b}{a} = 1$ [1]

Correct reading off graph. [1]

[Total: 20]

2 (c) (ii) Measurement of h to nearest mm with consistent unit. 0.900 m < h < 1.100 m [1]

(d) (ii) Value of $m_A - m_B$ = 20 g with consistent unit. [1]

(iii) Value of t with unit. t < 5 seconds [1]

Evidence of repeated measurements of t. [1]

(e) Absolute uncertainty in t in range 0.1–0.6 s. [1]
If repeated readings have been taken, then the uncertainty can be half the range.

Correct method of calculation to get percentage uncertainty. [1]

(f) Second value of $m_A - m_B$ = 40 g [1]

Second value of t. [1]

Quality: second value of t < first value of t. [1]

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

(ii) Justification of sf in k linked t and ($m_A - m_B$) or m_A and m_B or masses. [1]

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

(h) Identifying limitations marks and suggesting improvements

(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 and plot a graph/calculate more values of *k*.	One reading/few readings/take more readings and average.
B_p	Masses hit each other/ masses slipping off.	B_s	Use larger pulley/method of securing masses to hanger.	
C_p	Uncertain starting position	C_s	Method of fixing rule e.g. clamp rule/electromagnetic release mechanism	
D_p	Difficult to measure time as time short/reaction time large compared with time.	D_s	Drop through greater height/ expand on trap door mechanism/ light gate with timer/motion sensor with data logger/video timer with timer.	
E_p	Friction at pulley	E_s	Lubricate pulley	Friction between pulley and string
F_p	Retort stand moves	F_s	Method of fixing to the bench e.g. clamp/add weights	
G_p	Mass (values) not accurate	G_s	Use balance/method of measuring mass	

Do not credit parallax error.

[Total: 20]