UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

9702 PHYSICS

9702/32 Paper 32 (Advanced Practical Skills 2), 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 Table

(b) Measurements. One mark for each set of readings for l and t. [6]
If incorrect trend then –1 (incorrect trend is $l \uparrow t \downarrow$).
For values of l in specified range, if any value of time <1 s then –1.
Help from supervisor then –1.

Repeated values of t for each length. [1]

Range. $l_{min} \leq 12$ cm and $l_{max} \geq 48$ cm [1]

Column headings – each must include a quantity and a unit where appropriate. [1]
Ignore 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, t (s) or t in s or t in sec).

Consistency of raw readings – all values of l must be given to the nearest mm. [1]

Significant figures. Apply to $\sqrt{l}$. [1]
If l is given to 2 sf, then accept $\sqrt{l}$ to 2 or 3 sf.
If l is given to 3 sf, then accept $\sqrt{l}$ to 3 or 4 sf.
If l is given to 4 sf, then accept $\sqrt{l}$ to 4 or 5 sf.

Check the value of $\sqrt{l}$ for largest l. If incorrect, write in the correct value. [1]

Graph

(c) (i) Axes – scales must be chosen so that the plotted points must occupy at least half the grid in both x and y directions. [1]
Sensible scales must be used (not 3:10 etc). Indicate false origin with FO.
Scales must be labelled with the quantity which is being plotted. Ignore units.
Scale value labels must be no further apart than three large squares.

Plots – all observations must be plotted (write a ringed total on the graph). [1]
Ring and check the 'worst' plot. Tick if correct. Re-plot if incorrect.
Work to an accuracy of half a small square. Do not allow 'blobs' > half a small square.

Line of best fit. There must be at least five trend plots after allowing one 'rogue' point. If trend curved then allow curve but not straight line. [1]
Indicate best line if candidate's line is not the best line.

Quality of results – judge by scatter of points about a straight line.
Allow up to $\pm 0.25\,\text{cm}^{½}$. [1]
All points must be plotted for this mark to be scored (minimum 6 points).

Analysis

(c) (ii) Calculation of gradient – the hypotenuse of the Δ must be at least half the length of the drawn line, and read-offs must be accurate to half a small square. Method of calculation must be correct. [1]

y-intercept correctly read from graph or calculated using correct read-offs. [1]

Conclusions

(d) Method: p = gradient and k = intercept [1]

Valid units (s $cm^{-½}$ or s $m^{-½}$ for p, and s for k). [1]
Check for and penalise power-of-ten error in unit for p.

[Total: 20]

2 First readings

(b) (i) No help from SV with setting up the apparatus. [1]

(ii) Sensible practical detail such as 'position scale close to mass holder', 'view horizontally', 'view at eye level', 'view perpendicular to scale', 'allow for zero error', 'measure at several positions', 'use setsquare on bench to make ruler vertical'. (Do not allow 'repeated readings'). [1]

(c) (ii) New height, with unit, to nearest mm. [1]

New height < previous height. [1]

Uncertainty

(c) (iv) Percentage uncertainty in x, using Δx = 1 or 2 mm or half the range of repeated readings. Correct ratio idea required. [1]

Second readings

(d) (i) 2nd measurement of height with no current. [1]

(ii) Value of second I < first I (but don't allow zero for second I). [1]

(iii) Measurement of height with new current ≤ $h_{d(i)}$ [1]

Calculation

(d) (iii) Correct calculation of second deflection x [1]

Quality of data

(d) (iii) Larger I produces larger deflection (check from raw values). [1]

Analysis and conclusions

(e) Correct calculation to check proportionality (e.g. two values of k). [1]

Sensible comment relating to calculations and suggested relationship. [1]
Use 50% permitted variation in k if candidate does not suggest a value.

(f) (i) (ii) Limitations and improvements

Limitation (4 max)	Improvement (4 max)
A Two readings not enough	A Take more readings and plot graph
B Change in height very small	B1 Use longer wire / larger current / higher voltage
	B2 Use travelling microscope / vernier calipers (if method described)
C Parallax error in height measurement	C Use setsquare from rule to mass* / use mirror
D Rule not vertical	D Use setsquare on bench* / use plumbline / clamp rule
E Could not achieve 1.2 A / contact Resistance / current fluctuating	E Use higher voltage supply / clean contacts / use continuously variable supply
F Hard to measure *h* because mass moves	F Turn off fans / method of checking mass hasn't moved
G Hard to measure 45 cm length because wire not straight / croc clips move / wire slips in clamps	G Use smaller croc clips / reduce load on clips / solder connections / tighten clamps / measure the 45 cm with the wire straight

* do not credit here if already credited in **(b)(ii)** [8]

[Total: 20]