UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9702 PHYSICS

9702/33 Paper 3 (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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UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) (ii) Value of h_0 in range 0.70 m › h_0 › 0.50 m. Consistent with unit. [1]

(b) (iii) Value of *h,* less than h_0 in **(a)(ii)**, with unit. [1]

(c) Five sets of readings of *h* and *m* scores 5 marks, four sets scores 4 marks etc.
Major help from Supervisor –2 (setting up apparatus). Minor help from Supervisor –1. [5]

Range of *m*: [1]
To include 0.350 kg.

Column headings: [1]
Each column heading must contain a quantity and a unit.
The unit must conform to accepted scientific convention e.g. *m* / kg, *m*(kg) or *m* in kg, $(h_0 - h)/m$ / m kg^{-1}, 1/m / kg^{-1}

Consistency: [1]
All values of *h* must be given to the nearest mm.

Significant figures: [1]
Significant figures for every row of values of 1/*m* same as or one greater than *m* as recorded in the table.

Calculation: [1]
Values of $(h_0 - h)$ /m calculated correctly.

(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 that is being plotted.
Scale markings must be no more than 3 large squares apart.

Plotting of points: [1]
All observations in the table must be plotted.
Diameter of plots must be ≤ half a small square (no 'blobs').
Work to an accuracy of half a small square.

Quality: [1]
All points in the table must be plotted (at least 4) for this mark to be awarded. Scatter of points must be less than 0.5 kg^{-1} (0.0005 g^{-1}) of 1/*m* of a straight line.

(ii) Line of best fit: [1]
Judge by balance of all points on the grid about the candidate's line (at least 4 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 by the candidate.
Line must not be kinked or thicker than half a small square.

(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 in both *x* and *y* directions.
Do not allow Δx / Δy.

y-intercept: [1]
Either:
Check 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:
Check read-off of the intercept directly from the graph.

(e) Value of *P* = candidate's gradient. Value of *Q* = candidate's intercept. [1]

Unit for *P* (e.g. m) consistent with value, and *Q* (m kg^{-1}) [1]

[Total: 20]

2 (b) (ii) Value of θ_0 to the nearest degree or 0.5° in range $70° \leq \theta \leq 80°$ [1]

(iii) Value of θ with unit, $\theta < \theta_0$ [1]

(iv) Correct calculation of $(\theta_0 - \theta)$ [1]

(c) (i) Value of raw *d* with unit to nearest mm. [1]

(ii) Absolute uncertainty in $2\,\text{mm} < d < 5\,\text{mm}$. [1]
If repeated readings have been taken, then the absolute uncertainty can be half the range. Correct method shown to find the percentage uncertainty.

(d) Second value of θ_0 within 1 ºC of first value of θ_0. [1]
Second value of θ. [1]
Second value of $\Delta\theta >$ first value of $\Delta\theta$ (check second value of $d >$ first value of *d*). [1]
Evidence of repeat readings of *d* here or in **(c)(i)**. [1]

(e) (i) Two values of *k* calculated correctly. [1]

(ii) Justification of s.f. in *k* linked to significant figures in *d* and $\Delta\theta$. [1]

(iii) Sensible comment relating to the calculated values of *k*, testing against a criterion specified by the candidate. [1]

(f)

	(i) Limitations **4 max.**	**(ii)** Improvements **4 max.**	No credit/not enough
A	two results not enough	take more readings and plot a graph/ calculate more *k* values and compare	'repeat readings' on its own/ few readings/ take more readings and (calculate) average *k*/ only one reading
B	heat lost through sides and /or bottom	method to reduce heat loss/ lag/ insulate/ polystyrene container	use of lid/ heat loss in warming bowl/cup/ draughts/ heat loss to surroundings
C	temperature change is small/ $\Delta\theta$ values too close	time for longer/ higher starting temperature/ greater range of surface areas	
D	large (percentage) uncertainty in $\Delta\theta$	use thermometer with greater sensitivity or precision/ use thermometer that can read to 0.1 ºC	use more accurate thermometer/ thermometer not precise enough/ not just 'digital thermometer'
E	water in bowl barely covers (bulb of) thermometer	use larger volume of water/ use of thermocouple/ other small temperature sensor (e.g. probe)	not just 'digital thermometer' any reference to stirrer/ non-uniform temperature/ thermometer touching base
F	parallax error in measuring ***d*** / reason for difficulty in access in measuring ***d***	use dividers/calipers	string measurements to measure *d*
G	difficult to mark level with reason	method of making mark stay e.g. depth gauge/ calibrated marks/ marker on outside	

Do not allow: use of coloured ink/reaction time/fans/draughts/water left behind/beakers not accurate/ helpers.

[Total: 20]