UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

9702 PHYSICS

9702/35 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.

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1 (a) Raw value(s) of h to the nearest mm in range 5–15 cm. [1]

(b) (ii) Value of d with unit: $d < h$. [1]

(d) Six sets of readings of m and d scores 5 marks, five sets scores 4 marks etc.
Incorrect trend –1. Supervisor's help –1. [5]

Range of m: $\Delta m \geq 60$ g. [1]

Column headings: [1]
Each column heading must contain a quantity and a unit where appropriate.
There must be some distinguishing mark between the quantity and the unit, e.g. $\frac{m}{d}$ / kg m^{-1} but accept $\frac{m}{d}$ (kg m^{-1}).

Consistency of presentation of raw readings: [1]
All values of raw d must be given to the nearest mm.

Significant figures: [1]
Significant figures for $\frac{1}{d}$ must be to the same as, or one more than, the number of significant figures in d.

Calculation: m/d calculated correctly. [1]

(e) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
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.
Scale markings must be no more than three large squares apart.

Plotting of points: [1]
All observations in the table must be plotted.
Check that the points are correctly plotted. Work to an accuracy of half a small square in both x and y directions.
Do not accept 'blobs' (points with diameter greater than half a small square).

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be scored. Scatter of points must be less than ± 0.5 m^{-1} (0.005 cm^{-1}) of 1/d of a straight line.

(ii) Line of best fit: [1]
Judge by balance of <u>all</u> the 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.

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(iii) Gradient: [1]
The hypotenuse of the triangle used 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. The method of calculation must be correct.

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 in both *x* and *y* directions. Allow ecf of gradient value.
Or: Check the read-off of the intercept directly from the graph.

(f) Values of A = –gradient and B = intercept. [1]

Substitution of $d = h$ shown and $0.08\,\text{kg} < m < 1.0\,\text{kg}$ with consistent unit. [1]

[Total: 20]

2 (a) (ii) Value of m in g or kg. $45\,\text{g} \leq m \leq 55\,\text{g}$. [1]

(iii) Absolute uncertainty in m in range 1–5 g with unit.
Correct method shown to find the percentage uncertainty. [1]

(b) (iii) Value of V to at least 1 d.p. with unit. Supervisor help –1. [1]

(c) Raw value(s) of θ_1 to nearest °C. [1]

(d) (ii) Value of $\theta_2 > \theta_1$ with unit. [1]

(iii) Calculation of $(\theta_2 - \theta_1)$. [1]

(e) Second value of $V >$ first value of V. [1]

(f) Second values of θ_2 and θ_1. [1]

Second value of $(\theta_2 - \theta_1)$ > first value of $(\theta_2 - \theta_1)$. [1]

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

(ii) Justification of s.f. in k linked to raw data in V and $(\theta_2 - \theta_1)$. [1]

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

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(h)

	(i) Limitations **4 max.**	**(ii)** Improvements **4 max.**	Do not credit
A	Two readings are not enough (to draw a conclusion)	Take more readings and plot a graph/calculate more *k* values (and compare)	'Few readings'/ 'take more readings and calculate average *k*'/ 'only one reading'
B	Heat loss (to surroundings or beaker)	Method to reduce heat loss, e.g. lagging, lid	Switch off fans to reduce convection
C	Small value of $(\theta_2 - \theta_1)$/ % uncertainty in $(\theta_2 - \theta_1)$ is large	Method to increase $(\theta_2 - \theta_1)$ e.g. higher voltage, lower resistance, increased time, less water	
D	Low precision of thermometer	**Either**: thermometer with specified better precision, e.g. 0.1 °C, 0.5 °C **Or**: named device such as thermocouple or resistance thermometer.	Not accuracy
E	Resistor/bulb of thermometer is not completely immersed	Use narrower beaker	
F	Water is left behind in measuring cylinder	Method to measure mass of water, e.g. subtract mass of empty beaker from mass of beaker with water	Just "weigh water"
G	Resistor continues to give out heat when switched off/ temperature continues to rise after switching off	Wait until temperature reaches a maximum before reading	

Do not credit: precision of measuring cylinder; different starting temperatures of water; uneven temperature distribution in beaker; parallax errors in reading volume or temperature; reaction time error in timing.

[Total: 20]

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