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

9702/36 Paper 3 (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.

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

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

1 (b) Measurement for H in range 0.200 m to 0.900 m. [1]

(c) (ii) First measurement of m, to nearest 0.001 kg and in the range 0.045 to 0.055 kg. [1]

(d) Six sets of values for h and m scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend then –1. Help from supervisor –1.

Range: [1]
m values must include 0.070 kg or less, and 0.220 kg or more.

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. y^{-2}/m^{-2}, $1/m^2(1/\text{kg}^2)$ but not $\dfrac{1}{m^2/\text{kg}^2}$.

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

Significant figures: [1]
Every value of $1/y^2$ must be given to the same s.f. as (or one more than) the s.f. in y.

Calculation: [1]
$1/y^2$ calculated correctly.

(e) (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.

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

Quality: [1]
Scatter of points must be less than ± 50 m^{-2} (± 0.005 cm^{-2}) on the $1/y^2$ axis about a straight line. All points must be plotted (at least 5) for this mark to be scored.

(ii) Line of best fit: [1]
Judge by balance of all the points (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 if clearly indicated by the candidate.
Line must not be kinked or thicker than half a square.

(iii) Gradient: [1]
The hypotenuse must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square or better in both x and y directions.
The method of calculation must be correct. Do not allow $\Delta x/\Delta y$.

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

(f) p = value of gradient and q = — (value of intercept). [1]
Both values must be from **(e)(iii)**. Do not allow fractions.

Correct consistent units for p (e.g. $kg^2\,m^{-2}$) and q (e.g. m^{-2}). [1]

[Total: 20]

2 (b) 0.250 m ≤ a ≤ 0.350 m and 0.450 m ≤ b ≤ 0.550 m, both with a correct and consistent unit. [1]

Values of a and b given to nearest mm e.g. 0.350 m or 35.0 cm. [1]

(c) (ii) Value of R in range 0.05 m to 0.50 m (5 cm to 50 cm). [1]

Evidence of repeats (credit evidence here or in **(f)**). [1]

(d) Percentage uncertainty in R based on absolute uncertainty in range 0.002 m to 0.01 m (2 mm to 10 mm). [1]
(If repeated readings have been done then the absolute uncertainty could be half the range, unless this is zero.)
Correct method to get % uncertainty.

(e) Correct calculation of v with consistent unit. [1]

(f) (ii) Second values of a and b. [1]

Second value of R. [1]

Second R less than first R. [1]

Correct calculation of second v. [1]

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

(ii) Valid conclusion based on the variation in k being within (or outside) a stated criterion. [1]

(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/only one reading/take more readings and calculate average *k* /'repeat readings'
B	Difficult to locate start position /measure *R* owing to parallax	Method to locate start point e.g. plumb line/clamped vertical rule using set square to bench	'Parallax error'/parallax error linked to *a* or *b*
C	Difficult to locate end point /measure *R* owing to ball bouncing/skipping/sinking/rule displaced from ball	Method to locate end point of *R* e.g. vertical clamped pointer/tray without lip (so rule can be placed on sand)/sand on bench/carbon paper /painted ball/video with playback plus scale in shot/ detailed hot spot	Vague video methods/ball moves/smooth sand/change depth of sand
D	Difficult to release ball from rest/without exerting a force	Method of improving release e.g. use an electromagnet	Use a release mechanism
E	(Vertical) distance fallen is less than *a*	Method of measuring *a* to surface of sand/correcting the value of *a* by measuring depth of sand	
F	Difficult to make tube horizontal (as not flexible enough)/judge horizontal/ clamp blocks horizontally	Method to ensure tube is horizontal e.g. use reference line (window sill)/spirit level /measure several heights from bench.	
G	Ball sticks in tube/slows down due to e.g. sand in tube/bend in tube/kink in tube/too much friction	Method to overcome sticking e.g. use new ball each time /clean ball with cloth before putting back in tube/use wider tube/smaller ball/open track	Lubricate/clean tube

Do not allow 'rule is not perpendicular to bench'.
Do not allow unspecified computer methods.

[Total: 20]