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

9702/32 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.

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1 (a) Value of L in range 0.80 m › L › 0.60 m. Consistent with unit. [1]

(b) (iii) Value of h_0, less than 50 cm, to the nearest mm. [1]

(c) Six sets of readings of d and h scores 5 marks, five sets scores 4 marks etc.
Help from Supervisor –1. [5]

Range of d: [1]
To include 25.0 cm (0.250 m) or more **and** 10.0 cm (0.100 m) or less

Column headings: [1]
Each column heading must contain a quantity and a unit
The unit must conform to accepted scientific convention e.g. d / m, d(m) or d in m,
$(h - h_0)$/m, $(L/2 - d)^2$/m^2

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

Significant figures: [1]
All values of $(L/2 - d)^2$ to 2 or 3 s.f.

Calculation: [1]
Values of $(L/2 - d)^2$ 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 which 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).
Plots must be accurate to half a small square.

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be awarded. Scatter of points must be less than 0.5 cm (0.005 m) of $(h - h_0)$ 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 5 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.

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(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 $\Delta x / \Delta y$.

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 a = candidate's gradient. Value of b = candidate's intercept. [1]

Unit for a (e.g. m) and b (e.g. m^2) consistent with values. [1]

[Total: 20]

2 (b) (i) Value of ball diameter or d to the nearest 0.1 mm (or 0.01 mm). [1]
Values of ball diameter and d in range 5 mm < d < 25 mm. [1]

(ii) Absolute uncertainty is between 2 mm and 5 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.

(iii) Correct calculation of A with consistent unit. [1]

(c) (ii) Value of F, with unit. [1]
Evidence of repeat measurements of F here or in **(d)(ii)**. [1]

(d) (ii) Second value of d. [1]
Second value of A is given to the same number of s.f. (or one more s.f.) than d_2. [1]
Second value of F. [1]
Quality: When d increases (second d value is larger than first d value) F also increases (second F value is larger than first F value) and vice versa. [1]

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

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

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(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	difficult to form a perfect sphere or disc/diameter of sphere or disc varied	method to make uniform spheres/discs e.g. moulds	pre-sized spheres/ repeat diameter measurement and average
C	reason for difficulty in measuring *d* e.g. viewed through ruler/parallax error in *d*	method to improve measurement of *d* e.g. travelling microscope	eyes in line
D	difficult to pull newton-meter parallel to ruler/bench	method to ensure force is parallel to ruler e.g. use a long string/pulley and weights*	
E	difficult to judge reading on newton-meter when detaches with reason e.g. ruler moves suddenly/without warning (so difficult to read newton-meter at the instant the ruler starts to move)/force drops to zero immediately after detachment	method to read force at detachment e.g. newton meter with a 'max hold' facility/video and playback or freeze frame/ use system of pulley and weights or sand to measure *F**/ use force sensor and datalogger or computer*	video to take reading/ digital (electronic) newton meter/ parallax related to newton meter/ difficult to measure force/ issue of viewing ruler and meter simultaneously
F	contact area less than calculated disc area/bulging disc		
G	difficult to zero newton-meter when used horizontally	improved method to measure *F*: e.g. use system of pulley and weights or sand*/use force sensor with datalogger or computer*	zero error in newton-meter/ just a pulley

Do not allow: reaction time/human error/using vernier caliper/helpers/use of micrometer screw gauge/effect of temperature/change in stickiness of Blu-Tack.

*This answer can be credited as D, E or G (but not more than once).

[Total: 20]

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