UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9702 PHYSICS

9702/36 Paper 32 (Advanced Practical Skills 2), maximum raw mark 40

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1 (c) Measurements for all raw l in range 19.5 to 20.5 cm. [1]

(e) (i) Measurements for all raw h_1 and h_2 to nearest mm. [1]

(iii) Measurement for raw d to nearest mm, with unit, in range 1.5 to 2.5 cm. [1]

(f) **Five** sets of readings of h_1, h_2 and d scores 4 marks, four sets scores 3 marks etc. [4]
Incorrect trend then –1.
Help from supervisor then –1.

Range – [1]
d values used must include $d_{min} \leq 3$ cm and $d_{max} \geq 8$ cm

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. $\theta/^{o}$, 1/tan θ, sin θ, sin ($\theta/^{o}$) not sin $\theta/^{o}$, not (1/tan θ)/^{o}

Consistency of presentation of raw readings – [1]
All h values in the table must be given to the same precision.

Significant figures – [1]
S.f. for 1/tan θ must be the same as, or one more than, the minimum s.f. given for ($h_1 - h_2$) and l.

Calculation – [1]
1/tan θ calculated correctly.

(Graph) Axes – [1]
Sensible scales must be used, no awkward scales (e.g. 3:10).
Scales must be chosen so that the plotted points must occupy at least half the graph grid in both x and y directions.
Scales must be correctly labelled with the quantity that is being plotted. Ignore units.
Scale markings must be no more than three large squares apart.

Plots – [1]
All observations must be plotted.
Ring and check a suspect plot. Tick if correct.
Re-plot if incorrect. Work to an accuracy of half a small square.
Diameter of plots must be ≤ half a small square (no blobs).

Line of best fit – [1]
Judge by balance of all plots, at least 4 trend points, about the candidate's line.
There must be an even distribution of points either side of the line along the full length.
Line must not be kinked.

Quality – [1]
Scatter of points must be less than ± 0.25 cm in the d direction about the examiner's line.
All points in table must be plotted (at least 4) for this mark to be scored.

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(g) (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.

Intercept [1]
Check that the read-off from graph or the method of calculation (substitution of correct read offs into $y = mx + c$) is correct.

(h) Value of a = gradient and value of b = intercept. [1]
Unit for a (m^{-1} cm^{-1} or mm^{-1}) consistent with value and b (no unit). [1]

[Total: 20]

2 (b) (i) Raw length and width to nearest mm with unit. Help from supervisor –1 [1]
Values of length and width in range 1 cm to 10 cm. [1]
Correct calculation of A, with consistent unit. [1]

(ii) S.f. in A same as/one more than the (smallest) s.f. in length and width [1]
(not just "raw readings").

(d) (i) Measurement of F, with unit, $F < 10$ N. [1]
Evidence of repeated measurements of F. [1]

(ii) Uncertainty in measurements of F stated, in range 0.1 to 0.5 N. [1]

(e) Values of second length and second width. [1]
Correct calculation of A. [1]
Measurement of F. [1]
Second F = first F (within 1 N). [1]

(f) Justification of a valid conclusion based on two values of F being within (or outside) the uncertainty in **(d)(ii)**. [1]

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(g)

	(i) Limitations **4 max**	**(ii)** Improvements **4 max**	No credit/not enough
A	Two readings not enough (to draw a conclusion)/too few readings/only two readings.	Take many readings for different areas and plot a graph/compare more *F* values	Repeat readings Few readings One reading NOT average *F*
B	Maximum force reached without warning(suddenly)/ reading over quickly, link to short time	Method of recording maximum reading e.g. force sensor + data logger/video recording to find force/meter which retains max reading/ use masses and pulley system	Position sensors /parallax/computer methods/bald human reaction time error/ increase force slowly/fast paper/high speed camera/ slow camera
C	Reason for the problem of detecting paper movement/ difficult to look at meter and paper at same time.	Method to indicate movement e.g. contrasting colours of paper/drawing a reference mark	Difficult to know when paper moves. Fast movement
D	Position of eraser (and weights) not fixed/ Mass(weight) of eraser changes/irregularity of rubber shape (not rectangular)	Method to ensure same position e.g. mark position on top paper/method to ensure constant mass e.g. use malleable strip which can be bent to change *A*/ change total masses to account for change in mass of rubber/pile up unused rubber pieces on top/improved method to measure rubber e.g. vernier caliper	Keep mass constant
E	Variation in direction of force/misalignment of paper strips (which affects *F).*	Method to ensure direction is constant e.g. align strips along straight edge/draw a line to follow/method to equalise levels	
F	Uneven bench surface (leading to contact area being less than *A).*	Method to ensure smoother surface e.g. use named surface e.g. glass or melamine/sand the surface	Use smoother surface

X: Increase mass so increase the force (reducing % uncertainty in force).

Do not credit references to zero error/accuracy/digital meter friction between papers/re-zeroing after each experiment/2 people/paper tearing/clip deforming.

[Total: 20]

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