UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9702 PHYSICS

9702/32 Paper 32 (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.

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1 (a) First value for h to nearest mm [1]

(b) Measurements table [4]
Four marks for six sets of readings for m and h,
three for five sets, etc. (–1 if trend is positive, –1 if help from supervisor)

Table – range [1]
Values of m must be $\geqslant$ 10 g and $\leqslant$ 100 g. Values must include 10 or 20 g and 90 or 100 g with no interval greater than 20 g.

Table – column headings [1]
Each column heading must contain a quantity and a unit where appropriate.
Ignore units in the body of the table.
There must be some distinguishing mark between the quantity and the unit (i.e. solidus is expected, but accept, for example, m (g)).

Table – consistency of presentation of raw readings [1]
All values of h must be given to the same number of decimal places.

(c) (i) (Graph) 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. Ignore units.
Allow reversed axes but do not allow wrong graph.
Gaps between labels must not be greater than three large squares.

(Graph) Plotting – [1]
All observations must be plotted.
Ring and check a suspect plot. Tick if correct. Re-plot if incorrect (i.e. if plot is more than half a small square from the correct position).
Do not allow plots with diameter greater than half a small square.

(Graph) Line of best fit – [1]
Judge by scatter of at least 5 trend plots about the candidate's line.
There must be a fair scatter of points either side of the line.
Indicate best line if candidate's line is not the best line.

(Graph) Quality of results – [1]
Judge by scatter of points about a best fit line
All points in the table (which must be at least 5) must be within 0.5 'h-scale cm' of a straight line.
Do not award if wrong trend.

(ii) Gradient –
The hypotenuse must be at least half the length of the drawn line. [1]

Read-offs must be no more than half a small square from the line (if incorrect, write in correct value). [1]
Check for $\Delta y/\Delta x$.
Check value is consistent with trend.

(d) (i) Measurement – value for raw *d* in range 18.00 to 27.00 mm (or SV ±2.00 mm), and given to nearest 0.1 mm or nearest 0.01 mm. Unit must be given. [1]

Measurement – repeated readings for *d.* [1]

(ii) *A* calculated correctly. Allow ecf. Check value. Penalise power of ten error. If incorrect, write in the correct value. [1]

S.f. in *A* the same as or one more than the s.f. in raw *d*. [1]

(e) Gradient value from **(c)(ii)** equated to $-(k+\rho Ag)$. Allow ecf. Penalise sign error. [1]

Value for *k* in range 3.50 to 6.49 Nm^{-1} (or SV ±30%). [1]
Ignore sign. Unit required.
Do not award this mark if the gradient has not been used.

[Total: 20]

2 **(a)** Value of l, with unit, to nearest mm. [1]
If SV help, then –1.

(b) **(i)** First value of a ($\leqslant$ 25 cm) [1]

(ii) First value of b (less than a) [1]

(c) **(i)** Use named item as marker for rebound distance/ [1]
Place ruler under path and view vertically from above/
Use second brick as releasing point.

(ii) Percentage uncertainty in b [1]
If repeated readings have been done then the uncertainty could be half the range, otherwise absolute uncertainty must be at least 2 mm and no more than 10 mm.
Correct ratio idea required.

(d) First value of k substitution correct and value <1. There must be no unit. [1]

S.f. in value of k – must be 2 or 3 s.f. (but allow 4 s.f. if <u>all</u> raw data is to 3 s.f.) [1]

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

Evidence of repeat readings for first or second value of b [1]

Second value of b shows correct trend. [1]

(f) Calculation of % difference (or equivalent) in k values. [1]

Valid conclusion based on the two values of k (e.g. k is constant because values close), consistent with 20% difference as border between 'close' and 'not close' unless candidate has defined his own % difference. [1]

(g) Identifying limitations and improvements

	(g) (i) Difficulties (one from each box – max. 4)	(g) (ii) Improvements (one from each box – max. 4)	But <u>not</u>
A	Two sets of readings not enough.	Take more readings and plot a graph / calculate more *k* values.	Repeated readings.
B	Difficult to judge rebound point/distance <u>because</u> of movement / short static time.	Use video with slow playback / use position sensor to measure rebound / use sound of ball striking a block to judge rebound / use lightgate and refine its position.	Use computer or data logger / attach pointer to ball / change length of string / time rebound instead of measuring.
C	Difficult to release without exerting a force/movement.	Named, <u>realistic</u> method of release without a force (e.g. remote-controlled clamp).	
D	Parallax error in measuring rebound distance.	Observe shadow on screen.	View at eye level.
E	Inconsistent bounce / ball bounces at an angle.	Use smoother brick.	Use heavier ball.
F	Motion affected by air movement / ball swings around.	Turn off fans or air con / shield from draughts.	Air resistance / carry out in vacuum / constraining guides.
G	When measuring l it is difficult to judge centre of ball.	Suitable method for measuring diameter of ball.	

[8]

[Total: 20]