## 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

9702/31

Paper 31 (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.

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

• CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Page 2		Mark Scheme: Teachers' version	Syllabus	Paper
,		GCE A/AS LEVEL – October/November 2009	9702	31
(a)	First	values for $h$ and $z$ , to the nearest mm.		[1]
(b)	<ul> <li>Measurements – Add up the number of sets of values of z and h and put a ringed total by the table.</li> <li>Four marks for six sets of readings of z and h, three for five sets, etc.</li> <li>(-1 if help given by supervisor, -1 if wrong trend i.e. h↑ z↓)</li> </ul>			ed total [4]
	Maximum value for z - h greater than 6.0 cm			[1]
	Each Ignore There	mn headings column heading must contain a quantity and a unit when the units in the body of the table. The must be some distinguishing mark between the quantity solidus is expected, but accept, for example, h (mm)).		[1]
		sistency of presentation of raw readings w values of $h$ and $z$ must be given to the same number of	f decimal places.	[1]
(c)	: S S tl S	Graph) Axes Sensible scales must be used. Awkward scales (e.g. 3:10 Scale markings should be no more than 3 large squares a Scales must be chosen so that the plotted points occupy he graph grid in both <i>x</i> and <i>y</i> directions. Scales must be labelled with the quantity being plotted. Ig Allow reversed axes but do not allow the wrong graph.	apart. at least half	[1]
	F V	Graph) Plotting All observations must be plotted. Put a ringed total of plot Ring and check a suspect plot. Tick if correct. Re-plot if ir Work to an accuracy of half a small square. Penalise 'blobs' – dia. of plots must be < ½ a small squar	correct.	[1]
	) T	Graph) Line of best fit ludge by scatter of at least 5 trend points about the cand There must be a fair scatter of points either side of the lin ndicate best line if candidate's line is not the best line.		[1]
	) A	Graph) Quality of results ludge by scatter of points about the best fit line. All points in the table (of which there must be at least 5) righthin $\pm$ 0.3 cm (to scale) on the $h$ axis.	nust be	[1]
	`´T F v	Gradient The hypotenuse must be at least half the length of the drage Read-offs must be accurate to half a small square. If incovalue. Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$ ).		[1] correct [1]

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(d)	(i)	Raw value(s) for $d$ to nearest 0.1 mm or 0.01 mm 18.00 mm $\leq d \leq$ 27.00 mm. Unit required. Repeated readings for $d$ .	[1] [1]
	(ii)	A calculated correctly. Allow ecf. Check value. If incorrect, write in the correct value.	[1]
		Significant figures for A must be the same as, or one more than, the sig. figs. of the raw values of d.	[1]
(e)	Sub Cal (or	thod – <u>value</u> from <b>(c) (ii)</b> equated to $k/\rho Ag + 1$ ostitution methods lose both <b>(e)</b> marks culation - value for $k$ in range 4 to 6 Nm <sup>-1</sup> .(allow $3.50 \le k \le 6.49$ ). refer to supervisor's value). Unit required. Ignore SF. s mark is conditional on achieving the previous mark.	[1] [1]

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**Syllabus** 

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Page 4		Mark Scheme: Teachers' version	Syllabus	Paper
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(a) (i)		value of $l$ , with unit, to nearest mm. (40 $\leq l \leq$ 60 cm) help given by supervisor)		[1]
(b) (i)	First	value of $d$ ( 18 cm $\leq d \leq$ 22 cm) with consistent unit.		[1]
(ii)	•	5 di la 14 di 14 di 15 di 16 d	Ü	[2]
(iii)	Rang If rep	centage uncertainty in $d$ .  ge of absolute uncertainty: $2 \text{ mm} \le \Delta d \le 10 \text{ mm}$ .  Deated readings have been done then the uncertainty of ect ratio idea required. $x = 100\%$ implied.	can be half the ra	[1] ange.
(c) (i)	First	value of k, substitution correct. Consistent unit.		[1]
(ii)	Justi	fication for s.f. in value of <i>k.</i>		[1]
	Eithe	er: <i>k</i> must be given to same no. of SF, or one more tha	ın, <i>l</i> <u>and</u> <i>d</i> .	
		must be given to same no. of SF, or one more than, $\it l$ hever has the least no. of SF.	or d,	
(d) Se	cond \	values of $\mathit{l}$ and $\mathit{d}$ .		[1]
Evi	idence	e of repeat readings for first or second value of d.		[1]
Se	cond o	d less than first d.		[1]
<b>(e)</b> Pe	rcenta	ge difference (or fractional difference) in k values calc	ulated.	[1]
		conclusion consistent with uncertainty of 20% of $k$ , or candidate's stated uncertainty.		[1]

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## **(f)** Identifying limitations and suggesting improvements:

	(f) (i) Limitations/ sources of error (max 4 marks)	(f) (ii) Improvements (max 4 marks))	Ignore:
Α	Only two readings/two readings are not enough (to draw a valid conclusion)	Take more readings and plot a graph/calculate more k values	repeat readings
В	Hard to measure <i>d</i> because ball moves too quickly/ too fast/only stationary for short time	Use video and play back slowly/ frame by frame Use slow motion camera Use position sensor/motion sensor Allow light gates, adjusting position until beam interrupted	Use a high-speed camera/computer/data logger
С	Difficulty in releasing marble consistently/ from rest/without applying a force	Description of a mechanism to release marble e.g. slot in tube + card	Change angle
D	Parallax error in measurement of d	Description of method of reducing parallax error requiring additional equipment e.g. shadow projection	view at eye level view from above use a marker
E	Incorrect alignment/ inconsistent collisions/ different paths down tube	Use narrower tube	
F	Motion of ball affected by air movement/ ball swings around	Turn off fans/air con. Shield from draughts	Use a closed room/vacuum refs to air resistance heavier ball
G	Difficult to measure <i>l</i> because it is hard to judge the position of the centre of the ball	Measure diameter of ball using vernier calipers Measure <i>l</i> to top and bottom of ball and average.	

[Total:20]