#### UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

# MARK SCHEME for the May/June 2007 question paper

# 9702 PHYSICS

9702/31

Paper 31 (Advanced Practical Skills), 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

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Page 2	Mark Scheme	Syllabus	Paper
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Manipulatio	n, measurement and observation		
Successful	collection of data		
(b) Measure One ma	ements rk for each set of readings for <i>V</i> and <i>n.</i>		[6
(b) Apparate	us set up without help from supervisor.		[′
Range and	distribution of values		
<b>(c)</b> $n = 1$ or	2 and $n = 10$ or 11 must be included and no more than	a gap of three.	[1
Quality of d	ata		
	ge by scatter of points about the best fit line. east 5 plots are needed on the trend line for this mark t	o be scored.	[1
Presentation	n of data and observations		
Table: layoเ	ıt		
Each co Ignore u	headings ( $V/V$ , $1/V/V^{-1}$ only). Ignore $n$ column. lumn heading must contain a quantity and a unit where nits in the body of the table. ust be some distinguishing mark between the quantity		[1
Table: raw o	data		
` '	ency of presentation of raw readings. es of <i>V</i> must be given to the same number of decimal p	laces.	[1
Table: calcu	llated quantities		
If V is gi	1/V. ven to 2 s.f., then accept 1/V to 2 or 3 s.f. ven to 3 s.f., then accept 1/V to 3 or 4 s.f.		[1
(b) Values of	ven to 4 s.f., then accept 1/V to 4 or 5 s.f. of 1/V correct. value. If incorrect, write in the correct value. Allow sn	nall rounding error	[´
Graph: layo		, and the second	
(Graph) Axe		) are not allowed.	[1

Scales must be chosen so that the plotted points must occupy at least half the graph grid

Scales must be labelled with the quantity which is being plotted. Ignore units.

in both *x* and *y* directions. Indicate false origin with FO.

ı agc		ik ocheme	Cynabus	i apei
	GCE A/AS LE	VEL – May/June 2007	9702	31
Graph	: plotting of points			
(Graph	n) All observations must be pl Ring and check a suspect p Work to an accuracy of hal	olot. Tick if correct. Re-plot if ir	ncorrect.	[1]
Graph	: trend line			
(Graph		about the candidate's line. r of points either side of the line te's line is not the best line.	).	[1]
Analy	sis, conclusions and evalua	tion		
Interp	retation of graph			
(c) Gradient The hypotenuse of the $\Delta$ must be greater than half the length of the drawn line. Read-offs must be accurate to half a small square. Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$ ).			[1]	
. , ,	ntercept from graph or substi a false origin has been used t	tute correct read-offs into y = m hen label FO.	X + C.	[1]
Drawi	ng conclusions			
`´E	alue for <i>E.</i> spect between <b>4–5V</b> . Should neck the value. Unit required.	•		[1]

Expect **0.19–0.23** unless supervisor has used different resistors.

If a unit is given then this mark cannot be scored. 2/3 s.f.

Mark Scheme

**Syllabus** 

**Paper** 

Page 3

(d) Value for  $R_1/R_2$ .

Method of working must be correct.

[1]

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# 2 Manipulation, measurement and observation

#### Successful collection of data

- (a) (iii) Position of centre of mass of ball at equilibrium [1] (Value < 1m and appropriate unit. No more than 1 d.p. in cm.)
- (b) (i) Position of centre of mass of ball when displaced(ii) Position of centre of mass of ball at maximum height[1]
- (d) Second position of centre of mass of ball when displaced [1]
- (d) Second position of centre of mass of ball at maximum height [1]
- (b)/(d) Repeated measurements for maximum height [1]

# Quality of data

(d) Bigger x gives bigger h [1]

#### Presentation of data and observations

### Display of calculation and reasoning

- **(b), (d)** Values of *x* calculated correctly. (Displaced equilibrium position) [1] Both values required. Unit need not be stated but must be consistent. Calculations must be checked.
- **(b), (d)** Values of *h* calculated correctly. (Max height equilibrium position) [1] Both values required. Unit need not be stated but must be consistent. Calculations must be checked.
- (e) Correct calculation to check proportionality Possibilities include: Two calculations of  $x^2/h$  or ratio of  $x^2$  values and ratio of h values both calculated.

## Analysis, conclusions and evaluation

## **Drawing conclusions**

(e) Conclusion
Sensible comments supported by calculations and suggested relation.
Incorrect ideas score zero.

# Estimating uncertainties

(c) (ii) Percentage uncertainty in *h*. [1] Uncertainty in *h* is 2–10 mm. Whole numbers only. If repeated readings have been done then the uncertainty could be half the range. Correct ratio idea required, ×100 stated/implied.

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### Identifying limitations

(f) (i) Relevant points must be underlined and ticked.

Some of these might be:

[4]

- A Ruler not vertical.
- **B** Locating the **centre** of the ball (when reading ruler).
- C Parallax error.
- **D** Establishing **when** the ball is at its maximum displacement.
- **E** Only two displacements (are not enough to validate the conclusion).
- **F** Difficulty in the **release** of the mass (reference to force/vertical plane).

# Suggesting improvements

(f) (ii) Relevant points must be underlined and ticked. Some of these might be:

[4]

- A Sensible method to ensure ruler vertical.
- **B** Place the rule as close as possible to the mass/mark the <u>centre</u> of the ball with mark or pointer/use the bottom/top of the ball.
- **C** Measure at eye level/repeat to get eye in the right place/place the rule as close as possible to the mass.
- **D** Use video camera (play back) frame by frame/slow motion/position sensor <u>above</u> or <u>below</u>.
- **E** Need a wider range of displacements **and** plot a graph/find mean *k*.
- **F** Use a clamp/electromagnet to release the mass.

Do not allow 'repeated readings', 'human error'.

Do not allow 'use a computer to improve the experiment'.

[Total: 20]