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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CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Pa	ge 2	Mark Scheme GCE A/AS LEVEL – May/June 2007	Syllabus 9702	Paper 31		
Mai	ninulatio	•	9102	31		
Manipulation, measurement and observation						
Suc	Successful collection of data					
(b)	Measure One mar	ements rk for each set of readings for <i>V</i> and <i>n</i> .		[6]		
(b)	Apparatu	us set up without help from supervisor.		[1]		
Rar	Range and distribution of values					
(c)	<i>n</i> = 1 or :	2 and $n = 10$ or 11 must be included and no more than	a gap of three.	[1]		
Qua	ality of da	ata				
(Gra	. ,	ge by scatter of points about the best fit line. east 5 plots are needed on the trend line for this mark to	o be scored.	[1]		
Pre	sentation	n of data and observations				
Tab	ole: layou	nt				
(b)	Each col	headings (V/V , $1/V/V^{-1}$ only). Ignore n column. Tumn 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]		
Tab	ole: raw o	lata				
(b)		ency of presentation of raw readings. s of <i>V</i> must be given to the same number of decimal p	laces.	[1]		
Tab	ole: calcu	lated quantities				
(b)	If V is given	9		[1]		
(b)		of 1/V correct. value. If incorrect, write in the correct value. Allow sm	nall rounding erro	[1] rs.		
Gra	ph: layo	ut				
(Gra	Scal	s sible scales must be used. Awkward scales (e.g. 3:10 les must be chosen so that the plotted points must occ	upy at least half t			

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

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

Graph: plotting of points	
(Graph) 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.	[1]
Graph: trend line	
(Graph) Line of best fit (of 5 or 6) Judge by scatter of points 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.	[1]
Analysis, conclusions and evaluation	
Interpretation of graph	
(c) Gradient The hypotenuse of the Δ 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]
(c) y-intercept from graph or substitute correct read-offs into y = mx + c. If a false origin has been used then label FO.	[1]
Drawing conclusions	
(d) Value for <i>E.</i> Expect between 4–5V . Should be 1/y-intercept. Check the value. Unit required. 2/3 s.f.	[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

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(d) Value for R_1/R_2 .

Method of working must be correct.

[Total: 20]

[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]