ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2003

GCE

Physics A

Unit PHA3/P

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Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

Unit 3: Practical

Instructions to examiners

1 Give due credit to alternative treatments which are correct. Give marks for what is correct; do not deduct marks because the attempt falls short of some ideal answer. Where marks are to be deducted for particular errors specific instructions are given in the marking scheme.

2 Do not deduct marks for poor written communication. Refer the script to the Awards meeting if poor presentation forbids a proper assessment. In each paper candidates may be awarded up to two marks for the Quality of Written Communication in cases of required explanation or description. Use the following criteria to award marks:

2 marks: Candidates write legibly with accurate spelling, grammar and punctuation; the answer containing information that bears some relevance to the question and being organised clearly and coherently. The vocabulary should be appropriate to the topic being examined.

1 mark: Candidates write with reasonably accurate spelling, grammar and punctuation; the answer containing some information that bears some relevance to the question and being reasonably well organised. Some of the vocabulary should be appropriate to the topic being examined.

0 marks: Candidates who fail to reach the threshold for the award of one mark.

3 An arithmetical error in an answer should be marked AE thus causing the candidate to lose one mark. The candidate's incorrect value should be carried through all subsequent calculations for the question and, if there are no subsequent errors, the candidate can score all remaining marks (indicated by ticks). These subsequent ticks should be marked CE (consequential error).

4 With regard to incorrect use of significant figures, normally two, three or four significant figures will be acceptable. Exceptions to this rule occur if the data in the question is given to, for example, five significant figures as in values of wavelength or frequency in questions dealing with the Doppler effect, or in atomic data. In these cases up to two further significant figures will be acceptable. The maximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by SF and, in addition, write SF opposite the mark for that question on the front cover of the paper to obviate imposing the penalty more than once per paper.

5 No penalties should be imposed for incorrect or omitted units at intermediate stages in a calculation or which are contained in brackets in the marking scheme. Penalties for unit errors (incorrect or omitted units) are imposed only at the stage when the final answer to a calculation is considered. The maximum penalty is **one mark per question**.

6 All other procedures, including the entering of marks, transferring marks to the front cover and referrals of scripts (other than those mentioned above) will be clarified at the standardising meeting of examiners.

1 ***planning*:**

measurements:
(on recoiling ball)
measure distance recoiling ball takes to come to rest ✓
using metre ruler or tape measure ✓
[measure velocity of recoil ✓ by appropriate (not hand-held)
technique ✓ e.g. 'light gate' or 'motion sensor',
'data-logger' not 'computer' (details can be shown on diagram)

(to determine height of cushion above table
use ruler ✓
(made) vertical ✓
(ignore balance to measure mass
or measurements of incident motion)

strategy:
make initial k.e. [velocity] constant and find recoil distance
or velocity (by any method) for different heights of cushion ✓
compare recoil distance or (recoil velocity)^2 with (vertical)
height of cushion (providing initial k.e. remains constant) ✓
arrive at qualitative conclusion by drawing appropriate graph ✓
(give credit~ h,
for graphs of recoil k.e. ~ h, fraction of k.e. retained ~ h,
or Δk.e. providing initial k.e. is constant,
since recoil k.e.∝ (recoil velocity)^2

control:
any sensible control, e.g. ✓
always use the same horizontal flat, [level surface],
maintain distance ball has to travel to cushion throughout experiment,
use same ball throughout experiment,
ensure that incident velocity is perpendicular to cushion. etc)
initial k.e./velocity constant not acceptable as control measure)

difficulties:
(*difficulty* + *how overcome* = 2)

any **two** of the following
reduce uncertainty in measurements of recoil distance or velocity
by repeating and averaging results (only when initial k.e. is constant
and method is sensible)
reduce uncertainty in outcome of experiment
by repeating the experiment on another table
[or by repeating the experiment using a range of incident k.e. (velocities)

ensure incident k.e./velocity is constant by
use of a launch device e.g. a ramp ✓✓✓✓ $_{max}(8)$
(8)

2 ***implementing***

(a)	*accuracy*	centre of mass of ruler recorded to nearest mm	✓	
(b)(i)		x_0 and y_0 recorded in range 44.(0) to 46.(0) cm	✓	
(b)(ii)		k, 2 sig. fig., no unit, in range 0.60 to 0.70	✓	
(c)	*tabulation*	x/cm y/cm	✓✓	
	readings	5 sets, x range ≥ 15.0 cm (mark deducted for each missing set)	✓	
	significant figures	all x (including x_0) to mm and all y (including y_0) to mm	✓	
(d)	*quality*	5 points to ± 2 mm of straight line (providing suitably-scaled graph drawn)	✓	(*8*)

3 ***applying evidence and drawing conclusions***

processing

(d)	*axes*	marked y/mm, x/mm (deduct ½ for each missing, rounding down)	✓✓	
	scale	suitable (e.g. 8 × 8) [5 × 5, 2 × 8, 8 × 2 ✓]	✓✓	
	points	5 points plotted correctly with straight best-fit line drawn	✓	

deductions

(e)(i)	G (no unit), from suitable Δ (e.g. 8 × 8)	✓	
(e)(ii)	$\frac{k-G}{k(1+G)}$, no unit, $\frac{S}{(k-G)/k(1+G)}$ in range 195 to 205 g [190 to 210 g ✓]	✓✓	(*8*)

4 ***evaluating evidence and procedures***

(f)(i)	y_0 contains the largest percentage error	✓	
	because y_0 is the smallest measurement [$y_0 < x_0$]	✓	
(f)(ii)	mass of M should be larger than mass of ruler	✓	
	otherwise size of y_0 is reduced	✓	
(f)(iii)	wide range (1_{max} if x range < 15.0 cm)	✓	
	to accurately determine best-fit line [gradient] or		
	to produce measurable change in y	✓	(*6*)
			(*22*)