GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification A

PHAP Practical Examination

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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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.

Units 5 -9: PHAP: Practical

Question 1 AO3a: Planning

measurements:
(to determine the diameter of the ball bearings),
use a micrometer screw gauge ✓
(to determine the angular deviation, ϕ),
use a protractor (metre ruler accepted if algebraic method described) ✓ (*2*)

strategy:
locate **path** of ball bearing before and after deviation by bar magnet ✓
added detail e.g. use of carbon paper to produce inked track ✓
extrapolate recessive track until this meets (extrapolated) incident track,
then measure angle (between tracks) ✓
measure ϕ for different diameters of ball bearing, then plot ϕ against
diameter and determine optimum angle from (turning point on) graph ✓
(some explanation beyond bare statement expected) (*4*)

control:
maintain strength of magnetic field at point of closest approach ✓
[use same magnet in same position relative to path of ball bearing ✓]
maintain velocity (**speed** and **direction**) of ball bearing towards magnet ✓ (*2*)

difficulties:
(*difficulty* + *how overcome* = 2) any **two** of the following:
reduce uncertainty in ϕ (✓)
by determining recession direction from widely-separated points (✓) and/or
repeating runs and rejecting anomalous results (✓) and/or
by using trigonometry to determine angle, e.g. $\phi = \tan^{-1}(l_1/l_2)$ (✓) and/or
use slow speed [stronger field] to increase deflection (✓)

reduce uncertainty in diameter (✓)
by checking zero error on micrometer (✓) and/or
repeating along a different diameter(s) and **averaging** (✓)

ensure that speed when passing bar magnet is constant (✓)
by releasing ball bearing using a launch device, e.g. a ramp (✓)

ensure that bar magnet is correctly orientated (✓)
by using a set-square to align magnet perpendicular to incident direction (✓)

ensure that working surface is horizontal (✓)
by checking in two directions with a spirit level (✓)

reduce uncertainty in optimum angle read from graph (✓)
by increasing frequency of data collected around turning point (✓)
✓✓✓✓ max(*4*)
max(*8*)

Question 2 AO3b: Implementing

(a)	*accuracy*	initial period in range 1.8(0) to 2.0(0) s	✓	
(b)	*tabulation*	d/mm nT and T/s	✓	
	readings	5 sets of d and T (1 mark deducted for each missing) if d values ≤ 40 cm, 1 mark deducted if $n \leq 20$, 1 mark deducted	✓✓	
	significant figures	all d to mm, all nT to 0.1 s or better	✓	
	tabulation	$\log d$ $\log T$	✓	
(c)	*significant figures*	all derived data to 3 s.f. or all to 4 s.f. ✓		
	quality	5 points to ± 2 mm of straight line of negative gradient (providing suitably-scaled graph drawn)	✓	(*8*)

AO3c: Applying Evidence and Drawing Conclusions

Processing

(c)	*axes*	marked $\log d$/(no unit), $\log T$/(no unit) (½ mark deducted for each error rounded down)	✓✓	
	scale	suitable (e.g. 8 × 8) [5 × 5, 2 × 8, 8 × 2 ✓]	✓✓	
	points	points plotted correctly (check at least one) with straight best-fit line of negative gradient	✓	

Deductions

(d)		G to 3 s.f. from suitable Δ (e.g. 8 × 8)	✓	
		G negative, in range –1.90 to –2.10 or –2.0 [–1.80 to –2.20, –1.9 or –2.1 ✓] (1 mark deducted for missing sign)	✓✓	(*8*)

AO3d: Evaluating Evidence and Procedures

(e)(i) $n = -2$ (allow C.E. from (d)) ✓

(e)(ii) k has units $m\,s^2$ [$cm\,s^2$ or $mm\,s^2$] (allow C.E. from (e)(i)) ✓

(f) time multiple oscillations and **average** results ✓
to reduce random [human, percentage, stop-start]] error ✓

or repeat timings (not to be confused with above) ✓
to reveal anomalous results [systematic error] ✓

or set ruler in oscillation and wait before starting timing ✓
to allow transient oscillations to die away ✓

or use a fiducial mark **at centre of oscillation** ✓
to reduce parallax [systematic] error ✓

or use 'count-down' technique, correctly described ✓
to ensure that n is not miscounted/eliminate systematic error ✓

any 2+2 for (f) *(6)*

(22)