



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme January 2004

GCE

Physics A

Unit PHAP

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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

1 AO3a : *planning*:

measurements::

(to determine transit time for falling ring)

use suitable automatic data capture method triggered by signals from two suitable sensors (light gates allowed, 'stopclock' not allowed) ✓

connect sensors to data logger or fast timer (not 'computer') ✓

(means to measure some aspect of the ac supply either as a variable that will affect the transit time, or to use as a control method)

to measure or maintain current/pd/amplitude of supply, accept

(ac) ammeter, voltmeter or cro, or

[to measure or maintain frequency of ac supply, accept cro or data logger,

to measure or maintain turns per unit length, accept ruler] ✓

strategy:

measures transit time when coil has no effect (i.e. ring in free-fall)

and when some (quantifiable) adjustment is made to a variable that will

affect the transit time (e.g. to the ac supply current/pd/amplitude/frequency,

or to the number of turns/turns per unit length on the coil (✓)

change magnitude of chosen variable and repeat transit timing (✓)

inspect results for mathematical link/plot graph to determine

whether any relationship exists between (change in) transit time and variable (✓)

(max)✓✓

control:

use same start and stop positions for timing (✓)

use same release position for ring (✓)

use same relative positions of coil, tube and rod (✓)

use same rod [ring] dimensions (✓)

(max)✓

for frequency variation,
control current/pd/amplitude of ac output (✓) and number of coils (✓)

for current/pd/amplitude variation
control frequency of ac output (✓) and number of coils (✓)

for variation of number of coils,
control current/pd/amplitude of ac output (✓) and
frequency of ac supply (✓)
(any 2 linked)✓✓

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

any **two** of the following

(to) reduce the uncertainty (change) in transit time (✓)
repeat timing and average results (✓) and/or
repeat timing to check for anomalous results (✓) and/or
increase length of coil (to maximise transit time) (✓)

reduce the uncertainty in measurement made with cro (✓)
sensible detail, e.g. use of large gain to measure amplitude (✓)

ensure ring falls smoothly (✓)
by making tube and ring are coaxial (vertical) (✓)

✓✓✓✓ $\frac{\text{max}(8)}{(8)}$

2 AO3b : implementing

- | | | | |
|-----|--------------------|--|----|
| (a) | <i>accuracy</i> | l recorded to nearest mm, in range 50.0 to 60.0 cm | ✓ |
| (b) | <i>tabulation</i> | x/cm nT/s | ✓ |
| (c) | | x^2 T^4 | ✓ |
| (b) | <i>readings</i> | 5 sets of x and nT
(mark deducted for each missing set,
x range, < 30 cm, n or $\Sigma n < 20$) | ✓✓ |
| (b) | <i>significant</i> | all x to nearest mm, nT to 0.1 s or better | ✓ |
| (c) | <i>figures</i> | all x^2 and all T^4 to 3 s.f. or 4 s.f. | ✓ |
| (c) | <i>quality</i> | at least 4 points to ± 2 mm of straight line
(must be suitably scaled graph, curve loses mark) | ✓ |

(8)

**3 AO3c : applying evidence and drawing conclusions
processing**

- (c) *axes* marked T^4/s^4 and x^2/cm^2 ✓✓
($\frac{1}{2}$ deducted for each missing, rounded down)
- scale* suitable scale (e.g. 8×8) ✓✓
[$5 \times 5, 2 \times 8, 8 \times 2$]
- points* 5 points plotted correctly ✓
on best-fit line of negative gradient

deductions

- (d) G negative from suitable Δ (e.g. 8×8) ✓
 G in range -3.90 to $-4.20, -4.0$ or -4.1 ($s^4 m^{-2}$) ✓✓
[-3.75 to $-4.35, -3.8, -3.9, -4.2, -4.3$ ($s^4 m^{-2}$) ✓]

(8)

4 AO3d : evaluating evidence and procedures

- (e)(i) vertical intercept, l , read correctly \pm mm ✓
correct intercept for $(nT)^4$ plot acceptable ✓
 T_s in range 1.35 (s) to 1.60 (s), 1.4 (s) or 1.5 (s) from $\sqrt[4]{l}$ ✓
- (e)(ii) theoretical value of period, τ_s , correctly evaluated using $2\pi\sqrt{\frac{l}{g}}$,
 l correct and g sensible ✓
difference $|\tau_s - T_s| \leq 0.05$ s ✓
- (e)(iii) error in T makes biggest contribution towards error in T_s ✓
because T values are raised to 4th power (x values only squared) ✓

(6)

(22)