

GCE 2005
January Series



Mark Scheme

Physics Specification A

PHA3/P 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.

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Dr Michael Cresswell Director General

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.

Unit 3: PHA3/P: Practical

Question 1 AO3a: Planning

measurements:

- (to determine the thrust produced by propeller),
measure **extension** of spring (not length) **with** ref. to ‘scale’ or ruler ✓
- (to determine the electrical power supplied to motor),
measure current with ammeter **and** voltage with voltmeter ✓ (2)

circuit diagram:

- diagram to show voltmeter in parallel with motor, ammeter to give current through the motor, and means to vary current in motor i.e. variable resistor, potentiometer or variable power supply ✓ (1)

strategy:

- find power by calculating $V \times I$ ✓
- find thrust:
 - produce force-extension data for spring: find stiffness of spring by measuring gradient of force-extension graph ✓
 - thrust by calculating $k\Delta x$ ✓
 - (direct measurement of thrust by Newton meter- 1 mark only)
- repeat experiment using different power settings, then plot graph of power against thrust [extension] ✓ (4)

control:

- use same spring throughout ✓ (1)

difficulties:

(*difficulty + how overcome = 2*)
any **two** of the following

- reduce uncertainty in pointer position [confirm thrust is horizontal] (✓)
by comparing pointer to plumb-line [or use a set-square] (✓)

- reduce uncertainty in reading from horizontal scale (✓)
by sensible measure to avoid parallax error (e.g. use of mirror) (✓)
- reduce uncertainty in measurement of extension of spring (✓)
by using spring of low stiffness (✓) (long spring allowed)

- reduce uncertainty in graph (✓)
by using wide range of readings (✓) (*repeat and averaging not allowed*)

✓✓✓✓

max(4)

max(8)

Question 2 AO3b: Implementing

(a)	<i>accuracy</i>	H in range 102 to 108 cm	✓	
(b)	<i>tabulation readings</i>	h/mm m/g 6 sets, m range 50 g [6 sets, m range 40 g, or 5 sets, m range 50 g,] (1 mark deducted for each missing)	✓ ✓✓	
	<i>significant figures</i>	all (raw values of) h (H disregarded) to mm	✓	
(c)	<i>tabulation</i>	$\frac{1}{(H-h)^2} / \text{m}^{-2}$	✓	
	<i>significant figures</i>	all $\frac{1}{(H-h)^2}$ data to 3 s.f. or 4 s.f.	✓	
	<i>quality</i>	5 points to ± 2 mm of straight best-fit line [providing suitable scaled graph drawn]	✓	(8)

AO3c: Applying Evidence and Drawing Conclusions**Processing**

(c)	<i>axes</i>	marked $\frac{1}{(H-h)^2} / \text{m}^{-2}$, m^2/kg^2 (½ deducted for each missing, rounded down)	✓✓	
	<i>scale</i>	suitable (e.g. 8×8) [5×5 , 2×8 , 8×2 ✓]	✓✓	
	<i>points</i>	at least 5 points plotted correctly with straight best-fit line of positive gradient	✓	

Deductions

(d)(i)		G from suitable Δ (e.g. 8×8)	✓	
		$M\sqrt{G}$ in range 1.94 to 2.14, 2.0 or 2.1 m^{-1} [1.84 to 2.24, 1.9 or 2.2 m^{-1} ✓]	✓✓	(8)

AO3d: Evaluating Evidence and Procedures

- (e)(i) h measured at each end [or at **two** different points, not twice] ✓
- (e)(ii) $\frac{1}{(H - h')^2}$ read from graph for $m^2 = \left(\frac{M}{2}\right)^2$ ✓
 $(H - h')$ given in range 0.67(0) to 0.74(0) m ✓
- (e)(iii) diagram:
 - weight of ruler labelled, vertical arrow downwards at centre of ruler ✓
 - tension labelled, horizontal arrow along the line of string
 away from ruler at lower end ✓
 - reaction force at pivot labelled, arrow directed away from
 pivot in correct quadrant ✓
 - directed at **less** than 45° to the vertical ✓ _{max3}

(6)
(22)