



ASSESSMENT and
QUALIFICATIONS
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General Certificate of Education

Physics 5451

Specification A

PHA3/P Practical Examination

Mark Scheme

2007 examination - June series

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PHA3/P Practical Examination

Question 1	AO3a: planning	
	<p><i>measurements:</i> (to measure the thickness of the glass block), use vernier callipers or micrometer screw gauge (reject 'ruler'; should assume that only one block is available) ✓ (to measure the period of rotation of the rotor, T [accept nT]), use a stopwatch (reject rotations in a fixed time) ✓</p> <p><i>strategy:</i> measure T or nT of rotor (reject 'rate' or 'speed of rotation' but allow ecf in ${}_2S$ and ${}_3S$) with different types of absorber separately present ✓ (can be implied in sketch; no credit for cycles in fixed time but allow ecf in ${}_2S$ and ${}_3S$) measure T or nT with different numbers of perspex discs as the absorber and draw a graph of these data ✓ measure the thickness of the glass and use this in conjunction with the calibration graph to make a qualitative comparison between the absorption of light by the glass and the perspex ✓ [for assuming $5t_{\text{perspex}} = t_{\text{glass}}$, ${}_1M = 0$, ${}_{23}S = 0$]</p> <p><i>control:</i> require factors, other than the absorber, that will independently affect the intensity of light incident on the radiometer: maintain (relative) positions of lamp and radiometer [allow 'bulb'] ✓ maintain power output of [current in or voltage across] the lamp ✓ (reject 'same lamp', 'same power supply', 'same brightness/intensity' or 'constant frequency') maintain intensity of background lighting [use of blackout/dark room] ✓ reject 'turn off background lights' unless 'curtains drawn' is added</p> <p><i>difficulties: (difficulty + how overcome = 2) any two of the following:</i></p> <p>reduce uncertainty in T or nT of rotor (allow ecf rate/frequency but reject any PD marks if measuring cycles in a fixed time) ✓ by repeating timing and averaging [find T by nT/n] ✓ (for frequency/rate accept $f = n/nT$) and/or by using a fixed point as reference ✓ (accept 'fiducial mark': this can be shown in a diagram, but reject idea of marking vane/rotor) and/or by waiting to allow rotor to reach a constant rate of rotation ✓ and/or by waiting to allow (apparatus to reach) thermal equilibrium ✓ and/or by choosing suitable separation to increase period [reduce lamp power] ✓</p> <p>reduce uncertainty in thickness of glass block ✓ by repeating measurement at different points and averaging result ✓ and/or checking for zero error on the micrometer ✓</p> <p>ensure light from lamp incident on radiometer has passed through absorber [light has been formed into a narrow beam] ✓ by use of screens, light box or other valid suggestion ✓ (check diagram) (reject 'absorber placed close to radiometer')</p> <p>ensure incident light is perpendicular to absorber surface ✓ by use of set square ✓</p>	<p>2</p> <p>3</p> <p>3</p> <p>max 4</p>
	Total	max 8

Question 2	AO3b: implementing	
(a) (i) and (ii)	initial observations: m either 50 g or 100 g, $h > 500$ mm ✓ (deduct for any s.f. error in (b))	1
(b)	tabulation: h/mm m/g ✓✓	2
	results: nine additional sets of h and m ✓ (no credit if $m = \Delta m$) h from repeated readings, averages calculated ✓	2
	significant figures: all h to nearest mm (including part (a)) ✓ all m recorded consistently (including part (a)); if to kg, then all 3 s.f.) ✓	2
(c)	quality: at least 8 points to ± 2 mm of best fit line ✓ (providing suitably-scaled graph drawn)	1
	AO3c: applying evidence and drawing conclusions	
	axes: marked m/kg and h/mm ✓✓ deduct $\frac{1}{2}$ for each error or omission, rounding down	2
	scales: suitable (e.g. 8×8) ✓✓, [5×5 , 2×8 , 8×2 ✓]	2
	points: ten points plotted correctly (check at least one) with best-fit line drawn consisting of two straight-line sections of negative gradient; lines should be joined but tolerate some curvature or intersection where lines meet ✓ (no credit if $m = \Delta m$)	1
(d)	(i)/(ii) G_1 and G_2 from suitable Δs (e.g. 8×8): apply to larger values should be shown as negative ✓	3
	(iii) $\frac{G_2}{G_1}$, no unit, in range 2.37 to 2.63 or 2.5 ✓✓ [2.25 to 2.75 or 2.3, 2.4, 2.6 or 2.7 ✓]	
(e)	AO3d: evaluating evidence and procedures	max 2
	(i) measured h with ruler made vertical using a set-square ✓ checked in two (mutually) perpendicular directions ✓ repeated h readings e.g. for loading and unloading, and find average (only acceptable if evidence provided in table) ✓ avoid parallax by viewing ruler at eye level or by use of set square against vertical ruler to read scale ✓ wait until system is at rest [stable] (reject 'equilibrium') before measuring h ✓	
	(ii) in region where gradient is G_1 , the central spring is not placed under tension [thread is not tight] ✓ so system is easier to stretch [stiffness of system in this region is less] ✓ [central spring not placed under tension (thread is not tight) until region where gradient is G_2 ✓, so system is harder to stretch (stiffness of system in this region is greater or change in extension per unit mass is less ✓)]	
(iii) extend linear region where gradient = G_1 until $m = 1$ kg then read off h value (from horizontal axis): can be implied in sketch [extraopolating to find intercept, m_0 , then using $1 = G_1 h + m_0$] ✓ assumption is that the springs continue to stretch linearly/uniformly ✓ [not stretched beyond limit of proportionality or system continues to obey Hooke's Law; allow 'extension proportional to tension' or G constant] (reject 'mass doesn't reach floor', $m \propto h$, or ideas about elastic or plastic behaviour, e.g. springs do not reach the elastic limit)	2	
	Total	22