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ASSESSMENT and QUALIFICATIONS ALLIANCE

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	
	measurements: (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) ✓	**2**
	strategy: measure T or nT of rotor (reject 'rate' or 'speed of rotation' but allow ecf in $_2$S and $_3$S) with different types of absorber separately present ✓ (can be implied in sketch; no credit for cycles in fixed time but allow ecf in $_2$S and $_3$S) 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 $5t_{perspex} = t_{glass}$, $_1$M = 0, $_{23}$S = 0]	**3**
	control: 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	**3**
	*difficulties: (difficulty + how overcome = 2) any **two** of the following:* 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] ✓ 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 ✓ 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') ensure incident light is perpendicular to absorber surface ✓ by use of set square ✓	**max 4**
	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* = Δ*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 ½ 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* = Δ*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	
(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 ✓]	**3**
	AO3d: evaluating evidence and procedures	
(e) (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* ✓	**max 2**
(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 ✓)]	**2**
(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 $1 = G_1h + m_0$] ✓ 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**