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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 6451

Specification A

PHAP Practical Examination

Mark Scheme

2007 examination - June series

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PHAP Practical Examination

Question 1	AO3a: planning	
	measurements: to measure the dimension of the port that will be key variable, e.g. diameter or length [depth] (reject 'thickness', 'width' or 'volume' and reject 'radius', 'area' or 'circumference' unless calculated indirectly using the diameter) use a ruler [millimetre scale] or vernier callipers ✓ (reject micrometer) to determine the amplitude/(r.m.s.) voltage or 'loudness' (reject 'sound', 'amplitude of the loudspeaker'), use a microphone connected to a c.r.o. (accept suitable detail in sketch) [accept bland 'decibel meter'; for 'data logger' insist that a valid digital input device, e.g. 'sound sensor' be used] ✓ (reject 'sound meter, or sound detector)	**2**
	strategy: vary the frequency of the input signal to the loudspeaker (or $_{123}$S = 0) using a signal generator [variable frequency ac supply/generator] ✓ measure amplitude [(r.m.s.) voltage] (reject 'power') for different sound frequencies and plot a frequency-response chart (or $_{23}$S = 0) ✓ [for sound sensor/data logger or for decibel meter, accept 'sound level' or 'loudness'] repeat for different diameters [lengths] of the port so the behaviour of the speaker can be analysed as the dimension of the port is varied ✓ (can be implied, e.g. accept a sketch showing response curves on a single set of axes)	**3**
	control: maintain distance between loudspeaker [port] and microphone [dB meter] ✓ maintain orientation of the microphone ✓ maintain distance between loudspeaker and port ✓ maintain port direction/alignment ✓ maintain a key dimension of the port as the other is varied ✓ maintain constant amplitude/voltage/current/power from signal generator ✓ maintain constant type of voltage waveform from signal generator ✓ (reject 'same material, thickness, range of input frequencies, size of cabinet)	**max 3**
	difficulties: (difficulty + how overcome = 2) any ***two*** *of the following:* reduce uncertainty in measurement of the variable port dimension ✓ by repeating and averaging ✓ and/or checking that opening is sealed around port ✓ reduce uncertainty in c.r.o. reading✓ by adjusting Y-gain [using scale of suitable sensitivity] ✓ and/or measuring peak to peak voltage on c.r.o. ✓ and/or switch off time base ✓ and/or by maintaining orientation of the microphone ✓ reduce uncertainty in decibel meter reading ✓ by checking background reading with loudspeaker off ✓ check amplitude of signal generator remains constant ✓ by using c.r.o., voltmeter or ammeter ✓ eliminate/damp down reflected sound (from bench, walls or ceiling) ✓ by using sound-absorbing material [or a directional microphone] ✓ prevent background noise affecting results ✓ evidence of soundproofing room, e.g. use of screens, wave guide etc ✓	**max 4**
	Total	**max 8**

Question 2		AO3b: implementing	
(a)		accuracy: μ , 2, 3 or 4 sf, sensible value and unit, (e.g. 0.25 m (kg^{-1})) with *e* to mm, *e* or Σe > 5.0 cm ✓	**1**
(b)		tabulation: *m* /kg *nT* *T* /s ✓	**1**
		results: at least 6 sets of *m* and *nT*, including *m* = 100 g ✓ (ignore any set with *m* = 0 g; no credit if mass of hanger included with *m*) *T* from *nT* where *n* or $\sum n \geq 20$ ✓	**2**
		significant figures: all *nT* to 0.1 s or better ✓ (ignore s.f. in *T*)	**1**
(c)		tabulation: T^2 (*m*) ✓ (accept T^2 data added to first data table)	**1**
		significant figures: all T^2 to 3 s.f. or all to 4 s.f. ✓	**1**
		quality: at least 6 points to ± 2 mm of straight line of positive gradient (providing suitably-scaled graph drawn) ✓	**1**
		AO3c: applying evidence and drawing conclusions	
		axes: marked T^2/s^2 and *m*/kg ✓✓ deduct ½ for each missing, rounding down	**2**
		scales: suitable (e.g. 8 × 8) ✓✓ [5 × 5, 2 × 8, 8 × 2 ✓]	**2**
		points: at least 6 points plotted correctly (check at least one) with straight best-fit line drawn ✓ (no credit if mass of hanger included in *m*)	**1**
(d)		*G* from suitable Δ (e.g. 8 × 8) ✓ $\frac{G}{\mu}$ in s^{2}m^{-1} [or unit consistent with that given with μ], in range 3.79 to 4.27 or 3.9, 4.0, 4.1 or 4.2 ✓✓ [3.62 to 4.67 or 3.7, 3.8, 4.3, 4.4, 4.5 or 4.6 ✓] (allow error carried forward for order of magnitude error in (a))	**3**
		AO3d: evaluating evidence and procedures	
(e)	(i)	time multiple oscillations ✓ and/or repeat timings and average [to detect anomalies] ✓ and/or wait for transient oscillations [lateral motion] to dissipate before starting timing [count-down] ✓ and/or view oscillations with eye level with fiducial mark ✓ (any 3 = 2 marks, any 2 = 1 mark)	**2**
	(ii)	use of a suitable non-invasive sensor (or 0/2), in an appropriate position e.g. light gate at the centre of oscillation (accept evidence in sketch) ✓ [motion sensor placed directly above or below the oscillating mass ✓] sensible explanation of how to find *T* from data ✓ e.g. for light gate, *T* = time between one obscuration and the next but one (accept *T*/2 = time between successive obscurations) [for motion sensor: plot displacement/ time or velocity/time graph; *T* is time between adjacent peaks on graph ✓ (accept sketch to this effect)]	**max 2**
	(iii)	**resonance** is responsible for motion seen in student's experiment ✓ this cannot occur in candidate's experiment since mass is constrained to move vertically (or words to that effect; reject 'damping') ✓	**2**
		Total	**22**