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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5451

Specification A

PHA3/P Practical Examination

Mark Scheme

2007 examination - January series

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PHA3/P Practical Examination

Question 1	AO3a: planning		
	measurements (to measure amplitude/loudness/voltage of signal produced by microphone), use a cro [decibel meter, sound sensor attached to data logger (or via an interface to computer) or (ac) voltmeter] (accept evidence from figure 1) (to determine the tension in the wire; allow 'weight'/'mass of sand', reject 'amount'), use a balance [scales, newton meter] (suitable quantities should be identified for the award of these marks)	✓ ✓	**2**
	strategy place microphone inside (or close to) can B and attach to suitable output device (can be implied on figure 1 or other diagram; no ecf from *measurements* for incorrectly specified variable) correctly takes account of systematic error due to (weight of) container and (weight of) can B in determining the tension in wire measure a property analogous to the loudness of the transmitted sound: **amplitude/peak voltage** of ac voltage signal (on **cro**) ['**loudness**' reading on decibel meter; '**voltage**' for voltmeter but expect clear evidence that the reading is ac (accept 'peak' or 'rms', reject 'average')] repeat with different tension in wire and plot a **graph** of tension [weight/mass/stress] against amplitude [loudness/voltage] (reject 'volume')	✓ ✓ ✓ ✓	**4**
	control use wire of same material [type](allow 'same wire') use same dimensions of wire (accept same length or constant diameter/area, reject 'thickness') use same **amplitude** [voltage] of input signal to loudspeaker [**loudness**/**amplitude** of loudspeaker] (reject 'constant output'/'volume') use same position of microphone (relative to can B) (reject 'fixed frequency', 'constant room temperature')	✓ ✓ ✓ ✓	**max 2**

	difficulties *(difficulty & how overcome = 2) any two of the following:* reduce uncertainty in tension ✓ some sensible measure to increase reading, e.g. use a larger container, hence use more sand or use sand with high density ✓ reduce uncertainty in amplitude of signal on cro [loudness of reading shown by decibel meter] ✓ measure peak to peak and divide by 2 and/or ✓ increase Y-gain of cro [sensitivity of decibel meter] ✓ reduce/eliminate sound directly or indirectly transmitted to microphone ✓ by using a baffle (can be shown by annotation on figure 1) and/or ✓ by using sound-proofing/sound-absorbent material on surroundings (reject 'keeping quiet') ✓ ensure that amplitude of input signal to the loudspeaker remains constant ✓ by monitoring output of signal generator with cro ✓ ensure any extension produced in wire is negligible ✓ by using wire of large Young Modulus and/or ✓ by using wire of large diameter ✓	**max 4**
		Max 8

Question 2					
		AO3b: implementing			
(a)	(i)/(ii)	*accuracy*	V_0 and V_1 recorded with unit, values sensible	✓	1
			$\frac{V_0}{V_1}$ in range 1.21 to 1.23	✓	1
	(iii)		quantitative or qualitative explanation that that the concealed resistance < 1000 Ω **since** ($V_0 - V_1$) is less than V_1 [$V_1 > ½ (V_0 - V_1)$ or $V_0 < 2V_1$]	✓	1
(b)		*results*	7 voltmeter readings of decreasing magnitude	✓	1
		sig figs	all voltmeter readings in (a) and (b) to 0.01 V	✓	1
(c)		*tabulation*	$\frac{1}{V}$ $\frac{(1000+R)}{R}$ (ignore any units supplied here)	✓	1
		sig figs	each set consistently recorded to either 3 or 4 s.f.; being tolerant with last set when R = 100 Ω	✓	1
(d)		*quality*	all 7 points to ± 2 mm of straight line (providing suitably-scaled graph drawn)	✓	1
					8

		AO3c: applying evidence and drawing conclusions			
(d)		*axes*	marked $\frac{1}{V}$/V^{-1} and $\frac{(1000+R)}{R}$ (no unit) deduct ½ for each error or omission, rounding down	✓✓	2
		scales	suitable (e.g. 8×8) [5×5, 2×8, 8×2 ✓]	✓✓	2
		points	all 7 points plotted correctly (check at least one) with straight best-fit line drawn of positive gradient	✓	1
		deductions			
(e)	(i)	G from suitable Δ (e.g. 8×8)		✓	1
	(ii)	GV_0, no unit, in range 0.209 to 0.231 or 0.22 [0.198 to 0.242 or 0.21, 0.23 ✓] (allow unit error for ecf from graph)		✓✓	2
					8

		AO3d: evaluating evidence and procedures		
(f)	(i)	use **same number** of significant figures as **recorded** for V values (check that the student's statement is true)	✓	1
	(ii)	claim is false	✓	**max 2**
		because supply is delivering a current	✓	
		so there is a voltage drop across/energy transformed in the internal resistance inside the power supply (accept reverse argument)	✓	
		[claim is true providing assumption being made is that the internal resistance of the supply is zero = 1/3 max] (reject 'no current flows')		
	(iii)	remove 1000 Ω (from W and X); try (single) known values of resistor between W and X, measuring V each time	✓	1
		compare (V) to V_0 (no credit here for idea that $V = V_0$ when no resistor is connected between W and X)	✓	1
		when $V = \frac{V_0}{2}$, resistance of unknown and known resistors are equal	✓	1
		[for answer introducing new apparatus or disregarding instruction 'without shorting': give 2/3 max for good (quantitative) method, 1/3 max for poor (qualitative) method] (answers based on Ohm's Law gains no credit)		
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