



General Certificate of Education

Physics 6451

Specification A

PHAP Practical Examination

Mark Scheme

2008 examination - June series

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GCE Physics, Specification A, PHAP, Practical Examination

Question 1	AO3a: planning	
	<p>measurements:</p> <p>(to measure the (amplitude if the) voltage induced in the ribbon) use a cro or (ac) voltmeter (connected to the ribbon [microphone]) ✓ [voltage sensor connected to data logger]</p> <p>(reject ‘ammeter’ or ‘multimeter’; for the purposes of the exercise it is not necessary to make a distinction between peak and rms voltage)</p> <p>(to measure the frequency [period] of the incident sound) use a cro (connected to either the ac supply or to the ribbon) ✓ [accept (conventional) microphone connected to cro, sound sensor connected to data logger]</p> <p>strategy:</p> <p>measure period, T, [accept correct sketch]; determine frequency, f, using $f = \frac{1}{T}$ ✓</p> <p>measure and record (amplitude of) the voltage induced in the ribbon for a range of input sound frequencies; plot a graph of (amplitude of) voltage against frequency ✓</p> <p>determine the resonant frequency from the peak [turning point] on the graph ✓</p> <p>(accept evidence from sketch of graph; no credit for ${}_3S$ if ${}_2S = 0$)</p> <p>control:</p> <p>amplitude [intensity] of sound from loudspeaker by measuring with a decibel meter [microphone connected to a cro of voltmeter] or output pd of supply by measuring with a cro [voltmeter] or current in loudspeaker by measuring with an ammeter</p> <p>position [direction] of loudspeaker relative to ribbon by marking relative positions, fixing down equipment to bench, measuring with a ruler etc ✓</p> <p>keeping constant one named characteristic of the ribbon that would logically affect the resonant frequency; accept length, width or tension (no further qualification required; reject ‘use same ribbon [microphone], same strength [alignment] of magnet) ✓</p> <p>keeping ambient noise to a minimum [eliminating background noise] by use of soundproofing ✓</p>	<p style="text-align: center;">2</p> <p style="text-align: center;">3</p> <p style="text-align: center;">max 3</p>

	<p>difficulties: (<i>difficulty + how overcome = 2</i>) any two of the following:</p> <p>reduce uncertainty in frequency [period] ✓</p> <p>check that cro time-base is correctly calibrated by use of a signal source of known frequency and/or ✓</p> <p>ensure that continuously variable time-base control is switched off [only use stepped time-base settings] and/or ✓</p> <p>use large (horizontal) fraction of visible trace on cro display in calculating frequency; (i.e. 'measure T from nT, alternatively, adjust time base to expand width of one cycle; accept evidence from sketch of cro trace; allow 'more sensitive time base') ✓</p> <p>reduce uncertainty in amplitude of output from ribbon microphone ✓</p> <p>use suitable Y-gain setting so amplitude of trace is large (look for evidence in any sketch produced) [measure peak to trough [peak to peak] (i.e. $2 \times$ amplitude)] ✓</p> <p>(reject 'use strong magnet', 'switch off the time-base')</p> <p>reduce uncertainty in resonant frequency of ribbon ✓</p> <p>increase frequency of measurements around peak of voltage ~ frequency graph and/or ✓</p> <p>look for 2nd resonant peak in sensitivity at $2 \times$ fundamental frequency for confirmation ✓</p>	max 4
	Total	max 8

Question 2	AO3b: implementing	
(a)	<p><i>initial observations:</i> x_0 to nearest mm in range 275 to 285 mm (allow '28 cm' but deduct SF mark in (b))</p>	1
(b)	<p><i>tabulation:</i> x/mm V/V ✓</p> <p><i>results:</i> at least 15 sets of x and V for $10 \text{ mm} \leq x \leq 270 \text{ mm}$ ✓✓ [at least 10 sets ✓] x range at least 250 mm ✓</p> <p><i>significant figures:</i> all x to nearest mm (including part (a)) and all V to nearest 0.01 V or to nearest 0.001 V ✓ (allow mixed 3 and 4 figure V data for auto-ranging meters)</p>	5

(c)	<p><i>quality:</i> four points to ± 2 mm of (straight) best fit line in region where $10 \text{ mm} \leq x \leq 70 \text{ mm}$ ✓</p> <p>four points to ± 2 mm of (curved) best fit line in region where $70 \text{ mm} \leq x \leq 190 \text{ mm}$ ✓</p> <p>four points to ± 2 mm of (straight) best fit line in region where $190 \text{ mm} \leq x \leq 270 \text{ mm}$ ✓</p> <p>✓✓✓ earns Q = 2, any ✓✓ earns Q = 1, otherwise Q = 0 (Q is conditional on whether suitably-scaled graph drawn)</p> <p>AO3c: applying evidence and drawing conclusions</p> <p><i>axes:</i> marked x/mm and V/V ✓✓ deduct $\frac{1}{2}$ for each error or omission, rounding down</p> <p><i>scales:</i> suitable (e.g. 8×8) ✓✓, [5×5, 2×8, 8×2 ✓]</p> <p><i>points:</i> with continuous best-fit line consisting of two straight-line regions (these regions should be drawn with the aid of a ruler); the two straight line regions should be separated by shorter region of positive, decreasing gradient: no credit if this region is straight or not smooth (do not insist that the best fit line passes through (0, 0) or that it must be drawn to reach the V axis)</p> <p>minimum of ten points plotted; any point plotted incorrectly loses this mark (check any that look suspect) ✓</p>	7
(d) (i)/(ii)	<p>G_1 and/or G_2 from suitable Δ (e.g. 8×8) – apply to larger Δ ✓ (if a curve is drawn, insist on a tangent for the hypotenuse of the Δ)</p>	3
(iii)	<p>$\frac{G_1}{G_2}$, no unit, in range 2.25 to 2.75, or 2 s.f. in range 2.3 to 2.7 ✓✓ [2.00 to 3.00, 2 s.f. in range 2.1, 2.2, 2.8 or 2.9 ✓]</p>	
(e) (i)	<p>AO3d: evaluating evidence and procedures</p> <p>sketch E is correct ✓ [for three straight lines of decreasing gradient, allow 'sketch F is correct'] (sketches A or D cannot be true, sketches B or C may gain credit if x is reversed)</p> <p>G is constant when the paper width is constant or reverse argument ✓</p> <p>G is largest when width is smallest or reverse argument ✓ (accept 'cross-section' or 'area' for width and sensible ideas about resistance per unit length)</p>	4
(ii)	<p>d in range 50 to 90 mm (do not penalise if wrong best-fit line is drawn) ✓</p>	
(f)	<p>$\frac{G_1}{G_2}$ is unchanged (or 0/2) ✓</p> <p>because G_1 and G_2 are (proportionally) smaller ✓</p> <p>[if axes are reversed allow 'G_1 and G_2 are (proportionally) larger']</p>	2
Total		22