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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5451

Specification A

PHA3/P Practical Examination

Mark Scheme

2008 examination - January series

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PHA3/P Practical Examination

Question 1	AO3a: planning	
	measurements: (to measure the angle of incidence, α, of the aerofoil) use a protractor [use a ruler to make suitable linear method if trig method given]; don't penalise for failure to mention balance/mass reading ✓	**1**
	strategy: test or procedure to establish zero of α or $_{45}$S=0: switch on blower and adjust α until balance reading reverts to b_0, the reading when the blower was off (or when the balance reads zero again if balance previously tared); [note that certain trig methods can be used to ascertain when α = 0] ✓ (allow 'set zero of α in line with beam' or 'make aerofoil parallel bench'; don't accept 'read α when blower off') measure α and b [Δb if balance was tared] for different α or $_{2345}$S=0 ✓ (don't allow 'increase α until trend in b changes') plot graph of b or (b_0 - b) [Δb if balance was tared against α] or $_{34}$S=0 ✓ find stall angle from turning point [accept evidence from sketch of graph] ✓ recognises that stall occurs when b minimum [accept evidence from graph] ✓ (allow $_5$S even if $_{34}$S=0, providing $_1$S=1)	**5**
	control: position of blower (relative to aerofoil) [keep airflow horizontal or velocity of air constant] ✓ (horizontal) position of prism (relative to pivot) ✓ (ignore 'keep height of prism/position of counterweight constant' or vague statements such as 'don't move apparatus', 'keep airflow constant')	**2**
	difficulties: *(difficulty + how overcome = 2)* any **two** of the following: reduce uncertainty in α ✓ attach a long pointer to the shaft on which aerofoil is mounted and read off against (suitably enlarged) rotary scale [accept use of large diameter protractor] ✓ and/or use 360° scale, read α from both sides and average (detect anomalies) ✓ and/or by establishing α by correct trigonometry; explanation must involve measurement of two linear distances ✓ reduce uncertainties in balance reading, b ✓ use long beam [large distance from aerofoil to prism] ✓ and/or use short distance between prism and pivot ✓ and/or use aerofoil of long span [high airflow rate] to increase lift force ✓and/or repeat experiment with negative values of α and average ✓ and/or check calibration of balance using known masses ✓ and/or shield the balance from stream of moving air (but no credit for 'cut out drafts'/'close windows' etc) ✓ reduce uncertainty in stalling angle ✓ by increasing frequency of readings [decreasing $\Delta\alpha$] around the turning point of the graph ✓	**max 4**
	Total	**max 8**

Question 2		
(a)	**AO3b implementing** *initial observations:* I_0 recorded with unit, value sensible, e.g. in range 15 mA to 45 mA and greater than largest recorded I in (b); V_0 recorded with unit, value sensible, e.g. about 0.9 E ✓	**1**
(b)	*tabulation:* I/mA V/V ✓ *results:* 8 sets of I and V ✓✓ deduct 1 mark for each missing deduct 1 mark if largest recorded V < 0.85 V_0 *significant figures:* applies (a) and (b): all I to 0.1 mA or better ✓ applies (a) and (b): all V to 0.01 V ✓	**4**
(c)	*tabulation:* ($V_0 - V$)/V I/mA ✓ (don't insist on units here) *significant figures:* all ($V_0 - V$) to 0.01 V, all I to 0.1 mA or better ✓ (don't penalise SF errors in I in both (b) and (c)) *quality:* 7 of 8 points to ± 2 mm of straight line ✓ (providing suitably-scaled graph drawn) **AO3c applying evidence and drawing conclusions** *axes:* marked ($V_0 - V$)/V and I/mA ✓✓ deduct ½ for each missing, rounding down *scales:* suitable (e.g. 8 × 8) ✓✓ [5 × 5, 2 × 8, 8 × 2 ✓] *points:* 8 points plotted correctly (check at least one) ✓ with straight best-fit line of positive gradient drawn	**8**
(d)	G from suitable Δ (e.g. 8 × 8) ✓ (for false plot of V against I, result must be negative) in range 129 (Ω) to 136 (Ω) [0.129 (kΩ) to 0.136 (kΩ)] ✓✓ [125 (Ω) to 140 (Ω) or 0.125 (kΩ) to 0.140 (kΩ) or 0.13 (kΩ) ✓] (for false plot of V against I, deduct 1 mark)	**3**
(e) (i)	**AO3d evaluating evidence and procedures** R_T from $\frac{E}{I_0}$ in range 135 Ω to 165 Ω ✓ assumption that no current flows through R_B (during part (a)) ✓ [ammeter has no zero resistance/no voltage drop across ammeter ✓]	**max 3**
(ii)	$R_B > R_T$ (simple statement is adequate) ✓ since $V_0 > \frac{E}{2}$ ✓ (must include V_0 and E in explanation; reject bland 'because higher pd across R_B than across R_T')	
(f)	idea of maximising **range** (of I and/or V readings) ✓ [found minimum current (and then intermediate readings)] (accept idea that Δ/chosen based on $\frac{I_0}{n}$, where n is the number of sets)	**1**
(g) (i)	zero error on ammeter ✓ (reject idea of (constant) parallax error)	**2**
(ii)	best fit lines does **not pass through the origin** of the graph ✓ (no credit for simply explaining how graph would look if $I \propto (V_0 - V)$)	
	Total	**22**