Rewarding Learning

ADVANCED
General Certificate of Education
2012

Physics

Assessment Unit A2 3

Practical Techniques (Internal Assessment)

Session 1

[AY231]

TUESDAY 8 MAY, MORNING

MARK SCHEME

Instructions for Internal Assessment

1 **Mark strictly according to this mark scheme.** Do not agonise over awarding "charity" or "benefit of doubt" marks. Give credit for numerical answers only if they are within the ranges indicated in this mark scheme. Remember, every script will be checked later to ensure that candidates are not disadvantaged.

2 Mark in **red** ball-point pen. For each correct point in the scheme you are rewarding, place a tick in the text of the script; for each incorrect point, place a cross. Then add up the ticks for each part of a question for which there is a sub-total in square brackets, and write this total in the "Teacher Mark" column to the right of the text. When you have finished marking a question, write the total for the question as a ringed mark at the beginning of the question and in the appropriate box on the front of the script.

3 In marking graphs you will have to exercise some professional judgment, but other features must be marked strictly according to the scheme. In labelling the axes, candidates should give the label/unit. The mark for "Scales" is normally awarded only if the plotted points occupy at least half of the printed graph along each axis. In addition, the scale must be to an easily manageable factor, such as 1 : 2, 1 : 4, 1 : 5, 1 : 10, 1 : 20. A factor of, for example, 10 mm to represent 30 cm does not score because of the difficulty of accurately plotting or reading off values.

The credit for plotting the points is, following the normal tariff, 2 marks for plotting 5 points correctly and 1 mark for plotting 4. "Correctly" means to within $\pm$ one small square ($\pm$2 mm) on the printed grid in either *x*- or *y*-direction. The marker's professional judgment comes in here. One tick is to be awarded for drawing the best straight line through the points. Do not agonise over scoring (or not) this mark; your professional judgment will allow you to come to a decision very quickly.

In measuring the gradient, one mark is reserved for a "large triangle". This means that either rise or run (or both) must be at least 5 cm on the printed graph grid. Some candidates do not draw their triangle, but use points read off from the line. Provided the rise and/or run in this virtual triangle meet the 5 cm criterion, the mark is scored. Beware of candidates who read off their gradient points directly from a table. The marker must check that the points used actually **lie on the line** and meet the 5 cm test.

4 When you have finished marking the paper, add up the marks for the three questions in the "Teacher Mark" column in the box on the front page of the booklet and enter the total. Check this total by adding up all the sub-total marks for parts of questions throughout the script (**not** the ringed total question marks). The totals arrived at in these two different ways should agree. If you cannot get agreement after a re-count, go back to counting the individual ticks throughout the text of the script.

					AVAILABLE MARKS
1	(a)	• Headings to include no. oscillations and unit [1] • 5 sets of readings of multiple oscillations ⩾10 allow ⩾5 Readings (second marking point) Penalty [–1] if l not to 1 dp and/or t, av t, T not to 2 dp [1] • repetition (⩾2) [1] • average (may not be shown) [1] • periodic time 2 dp essential [1]	[5]		
		Penalty [–1] if values of T not decreasing as l decreases Penalty [–1] if l values wrong by 5 cm or not to 1dp			
	(b)	(i) Stating $T^2 = \frac{4\pi^2 n\, l}{g}$ [1] } Independent values Mapping clearly to $y = mx$ (+ c) ecf eq^n [1]	[2]		
		(ii) Gradient = $4\pi^2 n/g$ ecf **(i)** [1] n = gradient × $g/4\pi^2$ [1]	[2]		
		(iii) T^2 values correctly calculated from their T values (consistent dp)	[1]		
	(c)	Scales [1] Points [2] Best fit line of their plotted points [1]	[4]		
	(d)	Large triangle [1] Gradient calculated correctly [1] Subs into n = gradient × $\frac{g}{4\pi^2}$ and obtains a consistent value [1] } Independent marks			
		Quality n in range 0.61–0.77 (2 or 3 dp) [1]	[4]		
	(e)	Equation rearranged, e.g. = $\frac{T^2 g}{4\pi^2 l}$ ecf [1] Units cancelled **or** correct alternative method [1]	[2]		20

						AVAILABLE MARKS
2	**(a)**	**(i)**	V_0 value recorded – **no credit**			
		(ii)	I = 5 values decreasing in value	[1]		
			V_1 = 5 values increasing in value	[1]		
			V_2 = 5 values decreasing in value	[1]	[3]	
			Penalty [–1] not quoted to 2 dec. places: all values			
	(b)	**(i)**	Consistent values for R_Q	[1]		
			Use of $V_1/I = R_Q$	[1]	[2]	
			Penalty [–1] 10^n error – apply only once			
		(ii)	• Calculates % uncertainty in I			
			or calculates % uncertainty in V	[1]		
			• Adds % uncertainty I + % uncertainty V	[1]		
			• Converts % uncertainty to absolute uncertainty	[1]	[3]	
			or			
			Maximum V, minimum I	[1]		
			R_Q maximum	[1]		
			R_Q maximum – R_Q	[1]		
			Penalty [–1] for not using data from the bottom row			
	(c)	**(i)**	Consistent values for $1/V_2$ (2 or 3 sf)		[1]	
		(ii)	Scales (lose if origin compressed)	[1]		
			Points	[2]		
			Best fit line	[1]	[4]	
	(d)	**(i)**	Large triangle	[1]		
			Value of A consistent	[1]	[2]	
		(ii)	No y-intercept from this graph (vertical axis must be referenced)		[1]	
		(iii)	• R_Q and $1/V_2$ values on best fit line	[1]		
			• Sub into Equation 2.1 with their A value	[1]		
			• Consistent B value	[1]	[3]	
	(e)		B in range : 1080 Ω–1320 Ω (1.08 Ω–1.32 Ω)		[1]	20

						AVAILABLE MARKS
3	(a)	(i)	• signal generator **connected** to speaker	[1]		
			• microphone connected to CRO	[1]		
			• speaker output aligned with microphone's input	[1]		
			• test material inserted between speaker and microphone	[1]	[4]	
			Allow marks from a diagram			
		(ii)	Time-base/time-scale	[1]		
			Y-gain (Y-amplifier)/Y- sensitivity/V cm^{-1}	[1]	[2]	
		(iii)	Measure screen amplitude (in cm) (accept peak-to-peak)	[1]		
			ascertain scale on Y-gain	[1]		
			multiply cm by Y-gain scale	[1]	[3]	
	(b)		Control the distance between speaker and microphone or fixed A_o	[1]		
			Insert each sheet in turn and determine amplitude/voltage	[1]		
			Insert pairs of sheets/all three sheets (until $\geqslant$ 5 sets of results obtained)			
			Credit if points are made in **(a)(i)**	[1]	[3]	
	(c)		Correct ln equation or a correct plot	[2]		
			(Attempt at ln equation – award [1])			
			Measure gradient	[1]		
			Multiply by –1	[1]	[4]	
			Alternative			
			V_o determined/needed	[1]		
			How V_o is determined	[1]		
			Use equation to get A	[1]		
			Average	[1]		
	(d)	(i)	Fixed absorber thickness	[1]		
			Vary frequency of sound source	[1]	[2]	
		(ii)	Humidity or temperature or atmospheric pressure	[1]		
			Perform experiment over short time duration			
			or other suitable alternative	[1]	[2]	20
					Total	**60**