Rewarding Learning

ADVANCED
General Certificate of Education
2013

Physics

Assessment Unit A2 3

Practical Techniques
(Internal Assessment)
Session 1

[AY231]

THURSDAY 9 MAY, MORNING

MARK SCHEME

General 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 axis, 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 grid 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 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)	(i)	3 ‘b’ values (not $a + b$)	[1]		
			Values decreasing	[1]		
			Quality: for a = 40 cm, $35 \leqslant b \leqslant 45$	[1]	[3]	
		(ii)	Calculates one value for f correctly	[1]		
			Calculates f from 2 or 3 pairs and takes a mean	[1]	[2]	
			Penalty [–1] for averaging a and b			
		(iii)	Response consistent with f from **(ii)** AND explanation based on 2nd sig fig, i.e. given to 1 sig fig e.g. f is verified because 23 cm rounds down to 20 cm or lies between 24 cm and 15 cm		[1]	
	(b)		5 values for d recorded	[1]		
			d values increasing	[1]		
			1st d value in the range 10 cm–18 cm	[1]	[3]	
	(c)	(i)	$y = mx + c$ quoted	[1]		
			Intercept and gradient explicitly identified as 33 and f_2 respectively	[1]	[2]	
		(ii)	**Five** correct values	[1]		
			Values quoted to 2 sig fig	[1]	[2]	
		(iii)	Suitable scale, not from zero	[1]		
			All points plotted correctly	[2]		
			[–1] each point plotted incorrectly (to zero)			
			Good best-fit line	[1]	[4]	
	(d)		Two points on the best fit line selected that conform to a ‘large triangle’	[1]		
			f_2 consistent with candidate’s value **or** calculated using a point on BFL	[1]		
			Must be **negative** (anywhere)	[1]	[3]	20
2	(a)		**Three** pairs of V and I values (tabulated with units) V to 2 d.p.	[1]		
			Mean R value consistent with candidate’s V and I values	[1]		
			R value between 50 000 Ω and 62 000 Ω (ignore sf)	[1]	[3]	
			Penalty [–1] for averaging V and I if not penalised in **1(a)(ii)**			
	(b)		**10** V_d values	[1]		
			V_d values decreasing	[1]	[2]	
	(c)	(i)	ln (V_d/V)	[1]		
			10 values consistent with candidate’s voltage – Lost if used $\log_{10}$	[1]	[2]	
		(ii)	Labels consistent with those in Table 2.1	[1]		
			Scales	[1]		
			8 of 10 points correct	[2]		
			[–1] each further point plotted incorrectly to zero			
			Good best-fit line	[1]	[5]	

						AVAILABLE MARKS
	(d)	**(i)**	Re-writing Equation 2.1 in logarithm form Explicit mapping to $y = mx + c$	[1] [1]	 [2]	
		(ii)	Two points from best-fit line that conform to a "large triangle" Candidate obtains consistent gradient 200–740 (μF) ecf for R and gradient Beware 10^n errors here, ecf **(a)**	[1] [1] [1]	 [3]	
		(iii)	Intercept Anti-log ecf intercept V_0 within ± 1V of V_d at t = 0s Penalty [–2] if used V_d at t = 0s and **not** the intercept	[1] [1] [1]	 [3]	 20
3	**(a)**	**(i)**	(± 2 mm or ± 1 mm) Uncertainty using metre rule is ± 1 mm or ± $\frac{1}{2}$mm There is an uncertainty at each end of the string	 [1] [1]	 [2]	
		(ii)	Balance D Mass to 2 d.p. matches precision	[1] [1]	 [2]	
		(iii)	6.31×10^{-3} (kg m^{-1}) (Penalty [–1] for 10^n error and/or not to 3 sig fig) %U in m = 0.17% and/or %U in l = 0.11% (0.22%) %U in μ = 0.28% (0.39%) ecf their percentages	[2] [1] [1]	 [4]	
	(b)	**(i)**	Tension = weight Weight = mass (kg) × gravity	[1] [1]	 [2]	
		(ii)	$v = f\lambda$ At first position of resonance, $\lambda = 2l$	[1] [1]	 [2]	
		(iii)	Accurately drawn line from the vibrator pin to the pulley		[1]	
		(iv)	Increase, change, adjust frequency of signal generator (from zero) until maximum vibration amplitude or loop pattern is observed	[1] [1]	 [2]	
		(v)	• Measure the length equivalent of one cycle (or equivalent) • Use of time base setting • (Evaluate period by) time base setting × length of one cycle • Frequency = $\frac{1}{\text{Period}}$ [$\frac{1}{2}$] each round down		 [2]	
		(vi)	Graph T against v^2 (or correct alternative to get a linear graph) (Attempts to map Equation 3.2 to y = mx + c [1]) Gradient = mass per unit length (or correct alternative consistent with axes)	[2] [1]	 [3]	 20
					Total	**60**