Rewarding Learning

ADVANCED
General Certificate of Education
2014

Physics

Assessment Unit A2 3
Practical Techniques
Session 2

[AY232]

MONDAY 12 MAY, MORNING

MARK SCHEME

General Instructions for Marking

1 **Mark strictly according to this mark scheme**. Give credit for numerical answers only if they are within the ranges indicated in this mark scheme.

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 "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 "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)**	Heading to include number of oscillations counted and unit (using the solidus)	[1]		
			5 sets of readings for 5 or more oscillations at each length	[3]		
			Repetition for each length and average (may not be shown)	[1]		
			Period T to 2 d.p.	[1]	[6]	
			Penalty [–1] if values of T not decreasing as D decreases			
		(ii)	0.10, 0.15, 0.20, 0.25, 0.30		[1]	
	(b)	**(i)**	Rearrange to $\frac{T^2}{d} - \frac{A}{d^2} - B = 0$	[1]		
			Rearrange to $\frac{T^2}{d} = A.\frac{1}{d^2} + B$ and mapping to $y = mx + c$	[1]	[2]	
			S.E. $\frac{T^2}{d} = A.\frac{1}{d^2} - B$ and mapped [1]/[2]			
		(ii)	Values for T^2/d			
			Values for $1/d^2$		[1]	
		(iii)	Suitable labelled scales	[1]		
			4 or more points correctly plotted	[2]		
			Best fit line of their plotted points	[1]	[4]	
		(iv)	Large triangle	[1]		
			Gradient A calculated correctly (0.3 guide)	[1]		
			Unit $s^2 m$	[1]		
			B = intercept on y-axis when $1/d^2 = 0$	[1]		
			Their values	[1]		
			Unit $s^2\ m^{-1}$	[1]	[6]	20
2	**(a)**	**(i)**	Five values of pairs of voltage and current, [1] each pair		[5]	
			Penalties: [–1] for voltage not to 2 d.p. (once only) [–1] for current not to 2 d.p. (once only)			
		(ii)	Values of power dissipated by the bulb	[1]		
			and unit W (allow VA etc)	[1]	[2]	
	(b)	**(i)**	$\lg P = n \lg V + \lg B$ any form	[1]		
			Mapping	[1]	[2]	
		(ii)	Values for $\log(P/W)$	[1]		
			Values for $\log(V/V)$	[1]	[2]	
		(iii)	5 points correctly plotted	[2]		
			Best fit line of their plotted points	[1]	[3]	
		(iv)	Intercept	[1]		
			Anti-log value	[1]		
			B Quality 0.15–0.40	[1]	[3]	
		(v)	Draw extreme fit line	[1]		
			Anti-log value	[1]		
			$\%u = \frac{\Delta B}{B_{BFL}} \times \frac{100}{1}$	[1]	[3]	20

						AVAILABLE MARKS
3	(a)	(i)	Release from same point	[1]		
			Start from rest	[1]		
			And . . .			
			Length of slope using a metre rule to ±1 mm	[1]		
			Time using a stopclock or electronic gate circuit ±0.01 s	[1]		
			Diameter using vernier callipers ±0.1 mm	[1]		
			To find velocity divide the distance travelled by the time taken (to roll down the slope)	[1]		
			The mass = density × volume	[1]		
			Reliability improved by repetition **and averaging** time or diameter	[1]	[8]	
		(ii)	$8650 \times \pi \times \left(\frac{0.054}{2}\right)^2 \times 0.038$			
			= 0.753 kg	[1]		
			% u_{d2} = 0.37%	[1]		
			% u_L = 0.26%	[1]		
			Total % u = 0.63% ecf % u_s	[1]		
			u = 0.005 kg	[1]	[5]	
	(b)	(i)	Measure slope length *x* and vertical height *y* **or** protractor	[1]		
			Sin $\theta = y/x$ **or** description of method (any trig' method)	[1]	[2]	
		(ii)	Friction (on the slope)		[1]	
	(c)		$\bar{v} = \frac{u + v}{2}$ [1]			
			a = average velocity × 2/time to roll down the slope	[1]		
			or			
			$s = ut + \frac{1}{2}at^2$ and u = 0	[1]		
			$a = \frac{2s}{t^2}$	[1]	[2]	
	(d)	(i)	(KE = $\frac{1}{2}mv^2 = \frac{1}{2} \times 1.80 \times (1.36)^2$) = 1.66 J		[1]	
		(ii)	h = 0.12 m		[1]	20
					Total	**60**