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2018

Physics

Assessment Unit A2 3
Practical Techniques

[AY231]

WEDNESDAY 9 MAY, MORNING

MARK SCHEME

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Subject-specific Instructions

In numerical problems, the marks for the intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the final correct answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote correct units for intermediate numerical quantities.

Note that this “correct answer” rule does not apply for formal proofs and derivations, which must be valid in all stages to obtain full credit.

Do not reward wrong physics. No credit is given for consistent substitution of numerical data, or subsequent arithmetic, **in a physically incorrect equation**. However, answers to subsequent stages of questions that are consistent with an earlier incorrect numerical answer, and are based on physically correct equation, must gain full credit. Designate this by writing **ECF** (Error Carried Forward) by your text marks.

The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer marks, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer mark.

In marking graphs you will have to exercise some professional judgement, 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 ± one small square (± 2 mm) on the printed grid in either x- or y- direction. The marker’s professional judgement 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 judgement 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.

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					AVAILABLE MARKS
1	(a)		Multiple oscillations with correct heading including unit in table	[1]	
			More than one set of values averaged (minimum t 5s)	[1]	
			5 correct values of T	[1]	
	(b)		Log T = B log n + log A (In used ok)	[1]	
			Mapping to y = mx + c, both axes correct	[1]	
	(c)		Log (T/s) and log (n/no unit) or log n	[1]	
			Log T values correct	[1]	
			Log n values correct	[1]	
	(d)		x-scale		
			y-scale	[1]	
			Axes labelled	[1]	
			Points plotted, [–1] each error	[2]	
			Best fit straight line	[1]	
	(e)	(i)	Large triangle and correct values	[1]	
			Consistent calculation of gradient	[1]	
			(quality 0.45–0.55) quality of their graph	[1]	
		(ii)	Subs of point on line and gradient	[1]	
			Consistent value	[1]	
		(iii)	Anti-log value of intercept	[1]	
			Unit correct, s	[1]	20
2	(a)	(i)	Value to 1 mm	[1]	
		(ii)	5 values of deflection to nearest mm in cm	[1]	
			Decreasing	[1]	
		(iii)	F values correctly calculated all to at least 2 s.f.	[1]	
	(b)	(i)	Axes appropriately scaled and labelled	[1]	
			Points plotted to within ± one small square	[2]	
			Best fit line	[1]	
		(ii)	Correct points from large triangle	[1]	
			Correct calculation of gradient	[1]	
	(c)	(i)	78.0 cm or close to this value to nearest mm (77.5–78.5)	[1]	
		(ii)	b value approx. 3.00 cm to 2 d.p. } or 3 d.p	[1]	
			d value approx. 0.60 cm to 2 d.p. } or 3 d.p	[1]	
			Evidence of repeating and averaging both measurements	[1]	
	(d)		Correct subs into equation for E	[1]	
			E value in region of 1×10^6	[1]	
			Unit $N\,cm^{-2}$ or consistent with their E	[1]	
	(e)		The thickness, d (smallest measurement) contributes most	[1]	
			Comparison show larger % error	[1]	
			Calculation of at least one % error correctly	[1]	20

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					AVAILABLE MARKS
3	**(a)**	**(i)**	Correct units for h, x, v, g Shows rhs cancels to m	[1] [1]	
		(ii)	Non-linear from origin Correct curve	[1] [1]	
	(b)	**(i)**	Same height Released from rest Same distance from bottom of ramp to edge of bench (any 2)	[1] [1]	
		(ii)	$v = \sqrt{2gh}$ h is the height of the ramp	[1] [1]	
		(iii)	Board or similar surface placed on floor, which can be raised or platform on top of bench being raised (method to vary height) Height measured from bench/platform top to surface using metre-ruler/tape Distance x from **vertically below** edge of bench sand-tray or on carbon-paper to mark landing position Repeated and averaged At least 5 sets	[1] [1] [1] [1] [1] [1] [1]	
	(c)	**(i)**	Plot h against x^2 g = gradient × $2v^2$ (or correct alternatives)	[1] [1]	
		(ii)	Draw extreme fit line Measure gradient or new g value Percentage uncertainty $\frac{\Delta m \text{ or } \Delta g}{m \text{ or } g \text{ best fit}} \times 100\%$	[1] [1] [1]	20
				Total	**60**