Rewarding Learning

ADVANCED
General Certificate of Education
2019

Physics

Assessment Unit A2 3B

asssessing

Practical Techniques
and Data Analysis

[APH32]

FRIDAY 10 MAY, MORNING

MARK SCHEME

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.

						AVAILABLE MARKS
1	(a)		Reasonable best fit line drawn, not through (0,0)		[1]	
	(b)	(i)	Correct points from large triangle	[1]		
			Gradient correct from their points	[1]		
			Unit A V^{-1} or Ω^{-1} (consistent with gradient)	[1]	[3]	
		(ii)	1/gradient = R	[1]		
			R value consistent with their **(i)**	[1]		
			Calculates ± 10%	[1]		
			Consistent conclusion	[1]	[4]	
	(c)	(i)	Meter has a non-zero current value when p.d. or current is zero		[1]	
		(ii)	Doesn't go through the origin		[1]	
		(iii)	Value of y intercept = zero error	[1]		
			subs into y = mx + c	[1]		
			value	[1]	[3]	13
2	(a)		1/L to LHS of equation and q correctly to RHS	[1]		
			$\frac{1}{L} = \frac{2}{q}\sqrt{\frac{mg}{k}}\ \text{Sin}\,\theta\sqrt{\text{Tan}\,\theta}$	[1]		
			y = mx + c mapping with c = 0 or y = mx mapping	[1]	[3]	
	(b)		$q = \frac{2}{\text{gradient}}\sqrt{\frac{mg}{k}}$		[1]	4
3	(a)		A and B = m^2, h = m, g = $m s^{-2}$	[1]		
			Correctly cancels RHS to s	[1]	[2]	
	(b)		CSA of container = 7.27×10^{-3} m^2	[1]		
			B = 1.59×10^{-4} to 3 s.f.	[1]		
			fractional or % unc in t = 2.91%	[1]		
			in A = 0.208%	[1]		
			in $\sqrt{h}$ = 0.4%	[1]		
			Adds percentage unc = 3.518%	[1]	[6]	8
4	(a)		Values correct: –1.000, –0.398, –0.097, 0.079, 0.204 (correct values [1] to three d.p. [1])		[2]	
	(b)	(i)	Axes scaled correctly	[1]		
			Labels correct	[1]		
			Points plotted accurately	[2]		
			Best fit line	[1]	[5]	
			(Reverse axes penalty [–1])			
		(ii)	Intercept = 10 log $\left(\frac{P}{2\pi I_0}\right)$	[1]		
			Reads intercept correctly (guide 42)	[1]		
			Consistent value for P (guide 10^{-7})	[1]	[3]	

					AVAILABLE MARKS
		(iii) Draw extreme (best) **fit** line	[1]		
		Read new intercept and calculate new P	[1]		
		Difference in P and new P	[1]	[3]	13
5	**(a)**	Point at 0 at start	[1]		
		Points on gridlines correct $5 \times \left[\frac{1}{2}\right]$, round up	[3]	[4]	
		[–1] if no curve drawn			
	(b)	**(i)** T = 1/f or subs	[1]		
		$T = 6.67 \times 10^{-4}$ s	[1]		
		$10\,cm = 5 \times 10^{-4}$ s, or $\frac{3T}{4} = 5 \times 10^{-4}$ s or 13.3 cm equivalent to $T(6.67 \times 10^{-4})$	[1]		
		5×10^{-5} ($s\,cm^{-1}$) to 1 s.f.	[1]		
		Consistent unit	[1]	[5]	
		(ii) $\frac{T}{2} = 10\,cm$	[1]		
		$T = 1000\,\mu s$ (ecf **(b)(i)**)	[1]		
		$f = 1000\,Hz$ (ecf T)	[1]	[3]	12
				Total	**50**