New Specification

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Physics

Assessment Unit AS 3A

assessing

Practical Techniques and Data Analysis

[SPH31]

THURSDAY 4 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)**	Measurement of length, using (half-metre/300 mm) rule	[1]		
		Measurement of diameter, using micrometer screw gauge	[1]		
		Measurement of resistance, using ohmmeter/ammeter & voltmeter	[1]	[3]	
	(b)	Length = 280 mm quoted to 1 mm (270–290 mm)	[1]		
		Mean diameter = (0.44–0.47) mm quoted to 0.01 mm	[1]		
		Resistance = 0.8 Ω (consistent voltmeter/ammeter readings)	[1]		
		Multiple diameter measurements until consistency achieved	[1]	[4]	
		Any unit missing penalty [−1] once only.			
	(c)	CSA = 1.6×10^{-7} (m^2) – consistent with results or correct subs into $\frac{\pi d^2}{4}$	[1]		
		Equation or subs	[1]		
		Resistivity consistent with their results			
		S.E. if radius + diameter confused [2]/[3]	[1]	[3]	10
2	**(a)**	Workable experiment to obtain valid results from diagram –			
		labelled light source/incident ray with arrow and block	[1]		
		Angles i and r identified	[1]	[2]	
	(b)	Min range 20°	[1]		
		Results for >2 (>1) incident angles recorded	[2]([1])		
		Table headings in form i and r	[1]		
		Units in heading in form /°	[1]	[5]	
	(c)	$\frac{\text{Sin i}}{\text{Sin r}}$	[1]		
		1 value 1.4–1.6	[1]		
		Comment consistent with results	[1]	[3]	10
3	**(a)**	Adjust the position of the weight/move pivot position	[1]		
		Establish equilibrium/balance/horizontal/level	[1]		
		Record position of mass and record position of suspension or define distances from c.o.m. to pivot and mass to pivot	[1]	[3]	
	(b)	Suspension point recorded	[1]		
		Corresponding position of mass noted (accept corresponding distances)	[1]		
		Results for >1 suspension points recorded	[1]		
		Distances all to 1 mm	[1]	[4]	
		Any unit missing penalty [−1] once only			
	(c)	Evaluation of distances	[1]		
		Subs into moments eq^n	[1]		
		mass calculation consistent and between 70–120g	[1]	[3]	10

					AVAILABLE MARKS
4	**(a)**	Multiple oscillations timed ⩾5, Number stated	[1]		
		Multiple oscillations repeated	[1]		
		Times recorded to 0.01 s with unit/s	[1]		
		Data available for 2 different masses, 200g + 400g	[1]		
		Period calculations consistent with data to 2 d.p. with unit/s	[1]	[5]	
	(b)	Justifying Eq^{n} 4.1 as wrong, e.g. T not doubling as m doubles	[1]		
		Justifying Eq^{n} 4.3 as wrong, e.g. T not decreasing as m increases	[1]		
		Justifying Eq^{n} 4.2 as correct, e.g. T increasing as m increases but not in proportion	[1]	[3]	
	(c)	k calculated once	[1]		
		Multiple k values averaged correctly	[1]	[2]	
		If incorrect equation chosen max [1]/[2]			10
				Total	**40**