Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 3

assessing

Practical Techniques

Session 1

[AY131]

TUESDAY 13 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 later stages 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 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.

Section A

					AVAILABLE MARKS
1	**(a)**	20° angle of incidence and 40° angle of incidence [1] Paths drawn ([–1] for no normals) [1] emergent rays parallel to incident ray [1]		[3]	
		No arrows: penalty [–1]			
	(b)	**(i)** Both perpendicular distances consistent with rays (+ $L_{40°} > L_{20°}$)		[1]	
		(ii) Refractive index/width of block/wave speed		[1]	5
2	**(a)**	Sensible value of breadth to 1 decimal place (e.g. 21.1 mm) [1] Sensible value of thickness to 2 decimal places (e.g. 7.12 mm) [1]		[2]	
		(Penalty [–1] if no repeats)			
	(b)	Distance between point of suspension and centre of mass 15 cm [1] Distance between point of suspension and loop, e.g. 7.5 [1]			
		(Can be written 200 × 7.5 = m × 15)			
		Mass consistent with their results within range [1]		[3]	5
3	**(a)**	Extension consistent with values		[1]	
	(b)	Multiple oscillation (⩾5) **and** repeats and averages [1] *T* calculated correctly to 2 d.p. [1]		[2]	
	(c)	consistent *g* value calculated [1] $8.5 \leqslant g \leqslant 10.5$ [1]		[2]	5
4	**(a)**				

	OA	OB	OC
I/mA	3.17	1.06	2.09
V/V	1.47	1.47	1.47
R/Ω	463	1386	703

3 sets of results (constant *V* values, *I* values in order of largest, smallest, middle) [3]
Penalty [–1] *V* and/or *I* to 2 d.p.

(b) **(i)** OB 3 in series – 3 × resistance of OA [1]

(ii) OC 2 in parallel in series with 1 single – 1.5 × resistance of OA [1] [2] 5

Section A **20**

Section B

AVAILABLE MARKS

5 **(a)** $\rho \propto 1/T$ so ρ against T a curve in the correct sense [1]
Asymptotic to both axes [1] [2]

(b) **(i)** 3 sig. fig. [1]

(ii) T/K $1/T$/K^{-1} [1]

T/K	ρ/kg m^{-3}	$1/T/ \times 10^{-3}$ K^{-1}
273	1.29	3.66
313	1.13	3.19
353	1.00	2.83
393	0.878	2.54
433	0.815	2.31
473	0.746	2.11

(iii) $1/T$ values (as table) [1]

(iv) Scales [1]
points [2]
straight line [1] [4]

(c) **(i)** Large triangle [1], values [1] [2]
gradient = 350 ± 20 [1]
Units = kg m^{-3} K e.c.f. table [1] [4]

(ii) 101 000 Pa [1]
S = 101 000/352 or rearranged equation [1]
S = 286, consistent with their values [1]
Units = Pa kg^{-1} m^3 K^{-1} or J kg^{-1} K^{-1} [1] [4]
Using a point not on the BFL: Penalty [–1]

(d) Extreme line drawn [1]
New value obtained for gradient [1]
(286 – calculated value)/286 × 100 [1] [3] 20

Section B **20**

Total **40**