Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2016

Physics

Assessment Unit AS 3

assessing

Practical Techniques

Session 2

[AY132]

THURSDAY 12 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.

Section A

					AVAILABLE MARKS
1	**(a) (i)**	$34° \leqslant \theta \leqslant 36°$, $57° \leqslant \alpha \leqslant 61°$ } Integers only	[1]		
		and α correctly labelled on the diagram	[1]	[2]	
	(ii)	Typical: $1.4 \leqslant n \leqslant 1.6$ consistent with i = 35° and ecf α		[1]	
	(b)	$40° \leqslant C \leqslant 44°$ Integers only and correctly labelled on the diagram		[1]	
	(c)	K = consistent with candidate's data ECF – ignore sig. fig.		[1]	5
2	**(a)**	R_{2a} ~ 100 Ω, R_{2b} ~ 200 Ω, R_{2c} ~ 300 Ω ± 5Ω (accept 0.1, 0.2 etc)		[1]	
	(b)	V_s values within stated ranges	[1]		
		V_1 values increasing	[1]		
		All voltages recorded to 2 d.p.	[1]	[2]	
	(c) (i)	Three values of R_1, consistent with the candidate's data Ignore sig figs (reference value = 300 Ω)		[1]	
	(ii)	Response must have both components addressed, i.e. reliability is either good or bad and justified by the spread in values for R_1		[1]	5
3	**(a) (i)**	L = ??????? value + unit given to 1 mm Uncertainty + length recorded		[1]	
	(ii)	Reason: (± 1 mm (± 0.5 mm)) uncertainty (at each end) in metre rule plus (between 2 mm–7 mm) kinks and bends		[1]	
	(b)	Two (or more) diameters averaged, mean recorded to 2 d.p. (Penalty [–1] – scale misread by 0.50 mm) Range $0.5 \leqslant d \leqslant 1.0$ mm		[1]	
	(c)	$\%U_d = \frac{100 * (0.01)}{diameter}$			
		a value consistent with the candidate's mean diameter	[1]		
		Doubling $\%U_d = \%U_A$	[1]	[2]	5
		Alternative			
		• Max/min (2) A values calculated	[1]		
		• Use of A values to obtain $\%U_k$	[1]		
4	**(a)**	3 masses recorded (M, M + 500 g and M + 1000 g)	[1]		
		Repeated measurements of friction showing consistency	[1]	[2]	
	(b)	Mean frictional force		[1]	
	(c)	$F = \beta m$ Equation 4.1 selected	[1]		
		F/m calculated for each mass giving β to be (nearly) constant or a valid alternative	[1]	[2]	5

AVAILABLE MARKS

Section B

5 (a) (i)

d/mm	v/m s^{-1}
0.711	**3.71×10^{-5}**
0.559	**6.00×10^{-5}**
0.376	**1.33×10^{-4}**
0.234	**3.43×10^{-4}**
0.152	**8.12×10^{-4}**

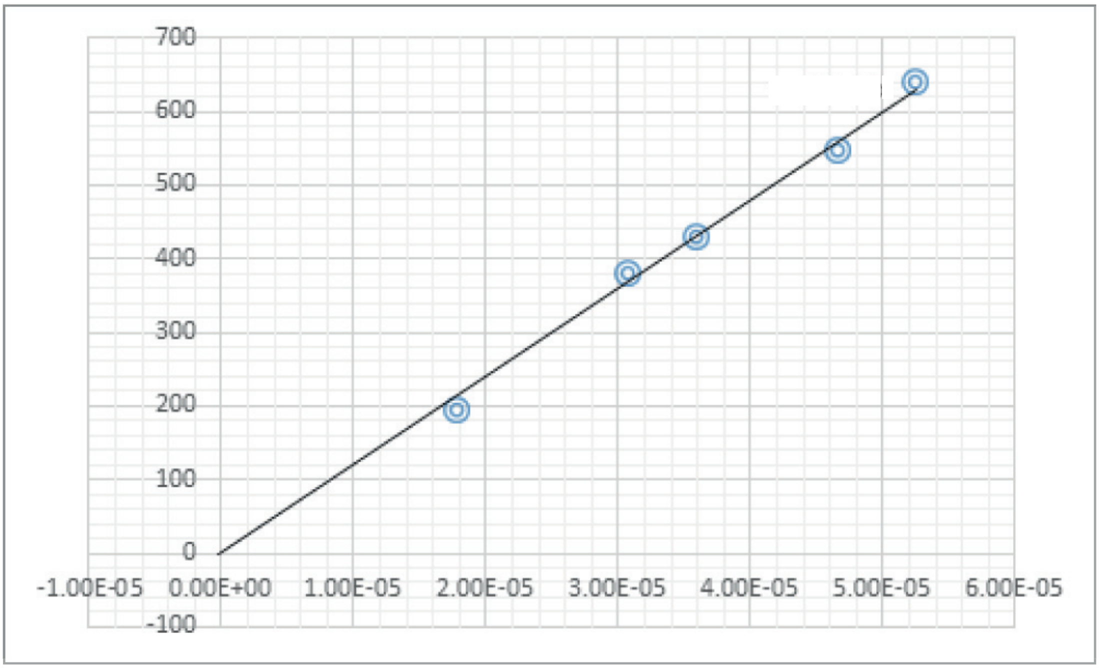
5 v values [–1] each mistake to zero
(3 sig. fig. essential) [–1] [3]
(10^n penalised once)

(ii)

Option	**x-axis**	**y-axis**	**Gradient**	**Unit**
1	$1/d^2$	v	$1/(5.33 \times 10^{10}) = 1.88 \times 10^{-11}$	m^3 s^{-1}
2	v	$1/d^2$	5.33×10^{10}	m^{-3} s
3	$1/(5.33 \times 10^{10} d^2)$	v	1	m^3 s^{-1}
4	v	$1/(5.33 \times 10^{10} d^2)$	1	m^{-3} s

Mark axes first; [1] mark for each axis [2]
Gradient [1] and unit [1] must be consistent with axes [2] [4]

(b) Scales [1]
5 points correctly plotted [2]
[–1] each mistake to zero
Best fit line [1] [4]



				AVAILABLE MARKS
(c) **(i)**	Large (virtual) triangle used	[1]		
	Consistent gradient found	[1]		
	Gradient BFL in range 11.0–13.0 × 10^n [1] e.g.			
	11000–13000 (11 × 10^6–13 × 10^6) (11–13)	[1]		
	Unit = A s m^{-1} (mA s m^{-1}) (mA s μm^{-1})	[1]	[4]	
(ii)	BFL gradient = (1.6 × 10^{-19})(8.82 × 10^{-7})n	subs [1]		
	n consistent with BFL gradient (guide value = 8 or 9 × 10^{28})	[1]	[2]	
(iii)	d = m/V	[1]		
	n/N_A = 9 × 10^{28}/6.02 × 10^{23} = 1.5 × 10^5 (guide) ecf (n)			
	subs/ans or calculating mass of one molecule	[1]		
	d consistent with n (~ 9000 kg m^{-3})	[1]	[3]	20
			Total	**40**