Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2012

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

THURSDAY 12 JANUARY, AFTERNOON

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.

					AVAILABLE MARKS
1	**(i)**	A unit from which all other units are derived.	[1]		
	(ii)	kg, m, s, A, mol, K ($6 \times [\frac{1}{2}]$, round down)	[3]		
	(iii)	$\sigma = \frac{F}{A}$	[1]		
		$kg\,m^{-1}\,s^{-2}$	[1]	[2]	6
2	**(a)**	3 (N)	[1]		
		Left	[1]	[2]	
	(b)	Scale used correct app Pythagoras	[1]		
		Drawing of resultant correct app trig	[1]		
		Magnitude of resultant using scale 5.4 ± 0.2 N	[1]		
		Correct direction 22° ± 5°	[1]	[4]	6
		(Penalty [–1] for wrong vector diagram)			
3	**(i)**	Diagram + labels	[2]		
	(ii)	Distance fallen, specified in text or diagram **(i)**	[1]		
		Time	[1]	[2]	
	(iii)	Graphical method			
		x-axis = t^2 y-axis = s	[1]		
		g = gradient × 2	[1]		
		or by calculation			
		calculating g once	[1]		
		repeat calculation and average	[1]		
		or using sensors			
		g determined directly	[1]		
		data logger programmed to use $g = \frac{v-u}{t}$	[1]	[2]	
	(iv)	Distance **or** time with an acceptable explanation for either consistent with method	[1]		

Quality of written communication

2 marks
The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling.

1 mark
The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks
The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2]

AVAILABLE MARKS

9

4 **(a)** **(i)** $26 \cos 50° = 16.7\ m s^{-1}$ [1]

$t = \frac{4}{16.7} = 0.24\ s$ [1] [2]

(ii) $26 \sin 50° = 19.9\ m s^{-1}$ [1]

$s = 19.9 \times 0.24 - \frac{1}{2} \times 9.81 \times 0.24^2$ [1]

$s = 4.49$ (m) [1] [3]

(b) **(i)** Disagree

(Vertical motion is zero)

Still has horizontal motion [1]

(ii) Equation to find time to reach max height [1]

Time to reach max height = 2.03 (s) [1]

Subtracting (2.03 – 0.24) [1]

Time = 2.03 – 0.24 = 1.79 (s) [1] [4]

10

5 **(a)** Clockwise moments = anticlockwise moments for equilibrium [1]

about any point [1] [2]

(b) **(i)** 4 T sin 30° = 2 × 200 [1] each side [2]

T = 200 (N) [1] [3]

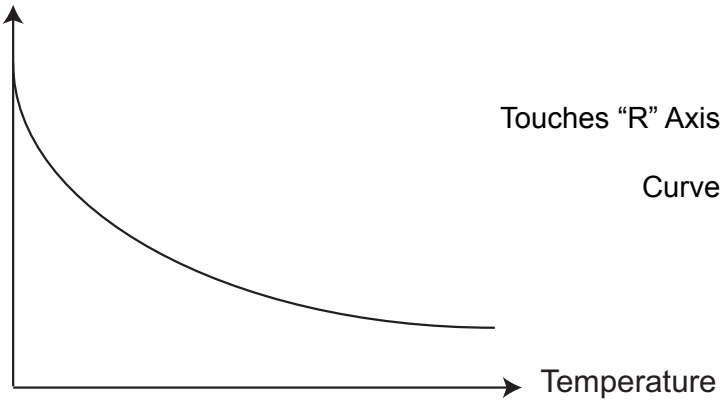
(ii) T maximum = 200 × 2.5 = 500 (N) [1]

New opposing moment = 1.2 × 60 × 9.81 + 400 = 1106.32 Nm [1]
or new tension (required) = 553 N

Maximum moment due to wire = 500 sin 30° × 4 = 1000 Nm [1] [3]
∴ wire breaks **or** 553 > 500

8

					AVAILABLE MARKS
6	**(a)**	P.E. = mgh **or** Subs P.E. = $8 \times 9.81 \times (11 - 2)$	[1]		
		P.E. = 706 (J)	[1]	[2]	
	(b)	**(i)** Power = Vi	[1]		
		$= 240 \times 1.5 = 360$ (W)	[1]	[2]	
		(ii) Useful P = $360 \times 0.8 = 288$N	[1]		
		$t = \frac{W}{P} \left(= \frac{706}{288}\right)$	[1]		
		t = 2.5 (s) e.c.f. **(a)**	[1]	[3]	7
7	**(a)**	Wire 1 extension = 780/130 = 6 (cm)	[1]		
		Wire 2 extension = 780/195 = 4 (cm)	[1]		
		PR length = 2.40 (m)	[1]	[3]	
	(b)	**(i)** Hooke's Law states $x \propto$ F	[1]		
		Graph must be linear (and through the origin)	[1]		
		Elastic limit is beyond linear section of graph	[1]	[3]	
		(ii) In **plastic** region	[1]		
		material becomes **permanently** extended	[1]	[2]	8
8	**(a)**	Energy converted from other forms to electrical E	[1]		
		when unit charge passes through it S.E. open circuit [1]/[2]	[1]	[2]	
	(b)	**(i)** $i \left(= \frac{V}{R}\right) = \frac{10}{4 + 12}$	[1]		
		i = 0.625 (A)	[1]	[2]	
		(ii) $= 0.625 \times 12$ e.c.f. **(i)**	subs [1]		
		= 7.5 (V)	[1]	[2]	
		(iii) Any **two** from: • Shorter cell life • Larger terminal p.d. • Larger current flow		[2]	8

					AVAILABLE MARKS
9	**(a)**	Current through material is not proportional to voltage across it	[1]		
	(b)	**(i)** Resistance  Touches "R" Axis [1] Curve [1]	[2]		
		(ii) More charge carriers at higher temperatures (Overcompensates for increased molecular interaction)	[1]		4
10	**(a)**	**(i)** $R_{BC} = 8\ \Omega$	[1]		
		$R_{AC} = 24\ \Omega\ (R_{BC} + 16)$	[1]		
		$i \left(= \frac{V}{R}\right) = \frac{6}{24}$ e.c.f.	[1]		
		$i = 0.25\,(A)$	[1]	[4]	
		(ii) Method 1: 0.25 A splits $\frac{4}{5}, \frac{1}{5}$ e.c.f. **(i)**	[1]		
		$0.05\,(A)$	[1]		
		or			
		Method 2: $V_{AB} = 16 \times 0.25 = 4\,V$			
		$\therefore\ V_{BC} = 2\,V$	[1]		
		$i = \frac{2}{40} = 0.05$	[1]	[2]	
	(b)	**(i)** $i = \frac{6}{16}$	[1]		
		$i = 0.375$ (A)	[1]	[2]	
		(ii) $0\,(A)$	[1]		9
				Total	**75**