Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2013

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

FRIDAY 11 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	**(a)**	**(i)**	863×10^{-6} or 8.63×10^{-4} (F) etc. [1]		
		(ii)	734 or 7.34×10^{2} etc. [Must combine indices] [1]		
		(iii)	482 or 4.82×10^{2} etc. [1]	[3]	
	(b)	**(i)**	kelvin [1]		
		(ii)	amount of substance [1]		
		(iii)	amp(ere) [1]	[3]	
	(c)		Intermediate (independent) mark for $F = \text{kg m s}^{-2}$ [1] Base unit of x = metre [1]	[2]	8
2	**(a)**	**(i)**	$v^2 = u^2 + 2as$ Eqn [1] $0 = 3.60^2 + 2(a)(2.60 - 1.40)$ Subs [1]	[2]	
		(ii)	$s = ut + \frac{1}{2}at^2$ Eqn [1] $s = 3.60(1.60) + \frac{1}{2}(-5.40)(1.60)^2$ Subs [1] $s = -1.15$ (m) [1] Distance = 0.25 m [1] ECF Distance = 1.40 + s	[4]	
	(b)		Straight line starting on the velocity axis at 3.6 or –3.6 and passing through the time axis (may have a positive or negative gradient) [1] Line finishes at ~ 1.60 s with a velocity magnitude greater than that with which it started [1]	[2]	8
3	**(a)**	**(i)**	$F = (6.00^2 + 4.00^2)^{\frac{1}{2}}$ [1] $F = 7.2(1)$(N) [1]	[2]	
		(ii)	a = 7.21/0.45 ecf **(i)** [1] $a = 16(.0)$ (m s^{-2}) [1]	[2]	
	(b)	**(i)**	a = gradient (or, for example, a = (2.0 – 0)/(0.16 – 0) etc.) [1] a = 12.5 to 12.0 (m s^{-2}) [1]	[2]	
			ecf **(a)(i)** ecf **(b)(i)**		
		(ii)	7.21– Friction = 0.450 × 12.5 [1] or Friction = 0.45 (16 – 12.5) Friction = 1.6–1.8 (N) [1]	[2]	8
4	**(a)**		$P = Fv$ $\left(\text{or } W = Fd \text{ and } P = \frac{W}{t}\right)$ Eqn [1]		
			$15.3 \times 10^3 = 0.44F$ Subs [1] Tension (= F) = 3.48×10^4 (N) Ans [1]	[3]	
	(b)		$\Delta GPE = mg\Delta h$ Eqn [1] $\Delta h = 163 \sin 33.5° = 90.0$ (m) Ans or subs [1] $\Delta GPE = 4.85 \times 10^6$ (J) Ans [1] (Standard Error: using Δh = 163 m gives 8.79×10^6 (J) →[2])	[3]	6

AVAILABLE MARKS

5 **(i)** Use of micrometer [1]
Multiple diameters averaged [1]
Use of $\frac{\pi d^2}{4}$ [1] ('r' must be defined, if used) [3]

(ii) Length [$\frac{1}{2}$]: fixed end to marker on unstretched wire [$\frac{1}{2}$] with tape rule (allow metre rule) [$\frac{1}{2}$]
Extension [$\frac{1}{2}$]: change in marker position relative to unstretched position [$\frac{1}{2}$]
(Tensile) force [$\frac{1}{2}$] : weight of the slotted masses [$\frac{1}{2}$]
[$\frac{1}{2}$] each, round down [3]

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. There are some errors in grammar, punctuation and spelling, but not such as to suggest 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]

(iii) $E = \sigma/\varepsilon$ = 1/gradient Eqn [1]
$E = 6.93 \times 10^{(10)}$ Any power Ans [1]
Pa or $N\,m^{-2}$ Unit [1]
(MPa or $MN\,m^{-2}$ Unit consistent with value [1]) [3] 11

6 **(a)** Extension $\propto$ Force [1] Allow equation if terms defined
if proportional limit not exceeded [1] [2]

(b) **(i)** $k = F/x = 54/23$ Subs [1]
$k = 2.3$ (or 2300) (2348) Ans [1]
$N\,mm^{-1}$ (or $N\,m^{-1}$) [1] [3]

(ii) x = 18.8 (mm) [1] ecf **(b)(i)**
Length = 3.42 (3.419) (m) [1] ecf for 'x' [2] 7
(3 sig. fig.)

							AVAILABLE MARKS
7	(a)	(i)	EMF			[1]	
		(ii)	current			[1]	
		(iii)	the volt			[1]	
	(b)	(i)	$P = VI$ $1200 = 230I$ $I = 5.22$ (A)	Eqn Subs Ans	[1] [1] [1]	[3]	
		(ii)	$Q = It$ $Q = 5.22$ (ecf **(i)**) (4.0 × 60) Q = consistent with **(i)** 1250 (1252) (C)	Eqn Subs Ans	[1] [1] [1]	[3]	
		(iii)	$E = QV = Pt$ $E = 1250$ (ecf **(ii)**) × 230 $E = (2.88 \times 10^5$ (J)) = 288 (kJ)	Eqn Subs Ans	[1] [1] [1]	[3]	12
8	(a)	(i)	Means of varying the voltage [1] Correct position of ammeter and voltmeter [1] Correct circuit symbols for ammeter, voltmeter, PSU or battery/cell [1]			[3]	
		(ii)	The graph is not linear or I $\not\propto$ V			[1]	
	(b)	(i)	Line of positive intercept and negative gradient (not touching Temp. axis)			[1]	
		(ii)	Increased number of free charge carriers [1] overcompensates for increased resistance due to increased molecular vibration [1]			[2]	7
9	(a)	(i)	$I_{36\,\Omega} = 422$ (mA) [1] Answers reversed [1] $I_{56\,\Omega} = 272$ (mA) [1] 10^n errors, apply once			[2]	
		(ii)	$I = I_{56\,\Omega} + I_{36\,\Omega}$ [1] or in words Q = It and since t is constant $Q = Q_{56\,\Omega} + Q_{36\,\Omega}$ [1]			[2]	
	(b)	(i)	$\frac{\square}{2}$ evaluated for parallel section [1] $R_T = \frac{5R}{2}$ [1] or $2R + \frac{R}{2}$ or $R + R + \frac{R}{2}$			[2]	
		(ii)	Current evaluated = $\frac{2E}{5R}$ or split evenly $\left(\frac{E}{5R}\right)$ [1] P.D. = 0.2 E [1]			[2]	8
						Total	**75**