Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2012

Physics

Assessment Unit AS 1

Module 1: Forces, Energy and Electricity

[AY111]

MONDAY 11 JUNE, 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 later tasks within 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)	Power		[1]	
		(ii)	Using P = W/t **or** equivalent	[1]		
			kg m^2 s^{-3}	[1]	[2]	
			ecf **(i)** for non base quantities max [1]			
	(b)		Machine 2	[1]		
			33.8×10^{12} (J s^{-1})	[1]		
			(allow correct conversion if wrong machine identified)			
			watt **or** W	[1]	[3]	6
2	(a)		a = gradient **or** $\frac{(v - u)}{t}$ = (0 − 40)/(15 − 2.5) Eqn or Subs	[1]		
			a = 3.2 Ans	[1]		
			negative (−3.2)	[1]	[3]	
	(b)		distance = area **or** average speed × time Eqn	[1]		
			any correct calculation	[1]		
			all calculations correct	[1]		
			d = 312.5 (m) Range 310 m–315 m Ans	[1]	[4]	7
3	(a)		Displacement has an implied direction, distance doesn't		[1]	
	(b)		107 km	[1]		
			39.0 km	[1]		
			South and West matched to magnitudes (180° and 270°)	[1]	[3]	
	(c)	(i)	Journey time = $\frac{2}{3}$ hour (accept 40 min)		[1]	
		(ii)	$v = \sqrt{171^2 + 36^2}$	[1]		
			= 175 (km h^{-1})	[1]		
			Direction = 12°	[1]	[3]	8
4	(a)		(Uniformly) accelerated motion in one direction	[1]		
			Constant speed in the **perpendicular** direction	[1]	[2]	
	(b)	(i)	subs into $v^2 = u^2 + 2as$, i.e. $0 = u^2 + 2(-9.81)(51)$	[1]		
			$u = \sqrt{(1000)}$ = 31.6227.... (must see)	[1]	[2]	
			Allow use of g = 10 m s^{-2}			
		(ii)	time to reach max height = 3.22 s	[1]		
			Horizontal comp = 136/6.44 = 21.1 (m s^{-1})	[1]	[2]	
		(iii)	$\theta = \tan^{-1}(31.6/21.1)$	[1]		
			θ = 56.3° ecf **(ii)**	[1]	[2]	8
			SE 36.8° (ecf t = 3.22 s) for [2]/[2]			

					AVAILABLE MARKS
5	**(a)**	acceleration is proportional to resultant force and inversely proportional to mass **or** equation with terms defined (F = **resultant** force) **and** acceleration and force act in the same direction		[1]	
	(b)	**(i)** Subs into F = ma, i.e. F = (1800)(8)	[1]		
		F = 14400 N	[1]		
		F = 14.4 (kN)	[1]	[3]	
		(ii) % reduction = (change time)/(new time)	[1]		
		% reduction = (6.3 − 4.5)/(6.3)	[1]		
		% reduction = 28	[1]	[3]	
		or			
		% reduction = (change in force)/(original force)	[1]		
		% reduction = (14.4 −10.3)/(14.4)	[1]		
		% reduction = 28	[1]		
		SE 40% → [2]/[3], SE 71% → [1]/[3]			
		Calculates new force (10.3) → [1]/[3]			7
6	**(a)**	Power is the rate of doing work (or using energy)	[1]		
		Efficiency is the fraction of input energy that does work	[1]	[2]	
		or equations with terms defined			
	(b)	**(i)** W = Fs	[1]		
		$F = 1.26 \times 10^6 \cos 35.0° = 1.03 \times 10^6$ (N)	[1]		
		$W = 2.47 \times 10^8$ (J) ecf F (or s)	[1]	[3]	
		(ii) $0.803 = (2.47 \times 10^8)/E$ **or** $E = 3.08 \times 10^8$ (J) ecf W	[1]		
		$P = 3.08 \times 10^8$ (J)/(7 × 60) ecf E	[1]		
		$P = 7.32 \times 10^5$ (W) ecf **(i)**	[1]	[3]	8
		SE 4.74×10^5 → [1]/[3]			
7	**(a)**	**(i)** More slotted masses are added		[1]	
		(ii) Extension = difference in position on the mm scale relative to the position when no mass is suspended		[1]	
	(b)	**(i)** (Must be recorded correct to 3 sig. fig.) **same sf or dp as raw data**		[1]	
		(ii) It confers **reliability** **or** it identifies whether the proportional or elastic limit is exceeded		[1]	
		(iii) ratio of extension to (unstretched) length **or** $\varepsilon = \frac{x}{L}$ with x and L defined		[1]	
		(iv) Calculates correct values for E (~1.2×10^9 Pa)			
		or eqn $E = \frac{FL}{Ax}$	[1]		
		Averages two or more calculated values	[1]		
		Quotes answer to 3 sig. figs. (1.20×10^9 **or** 1.21×10^9)	[1]	[3]	8

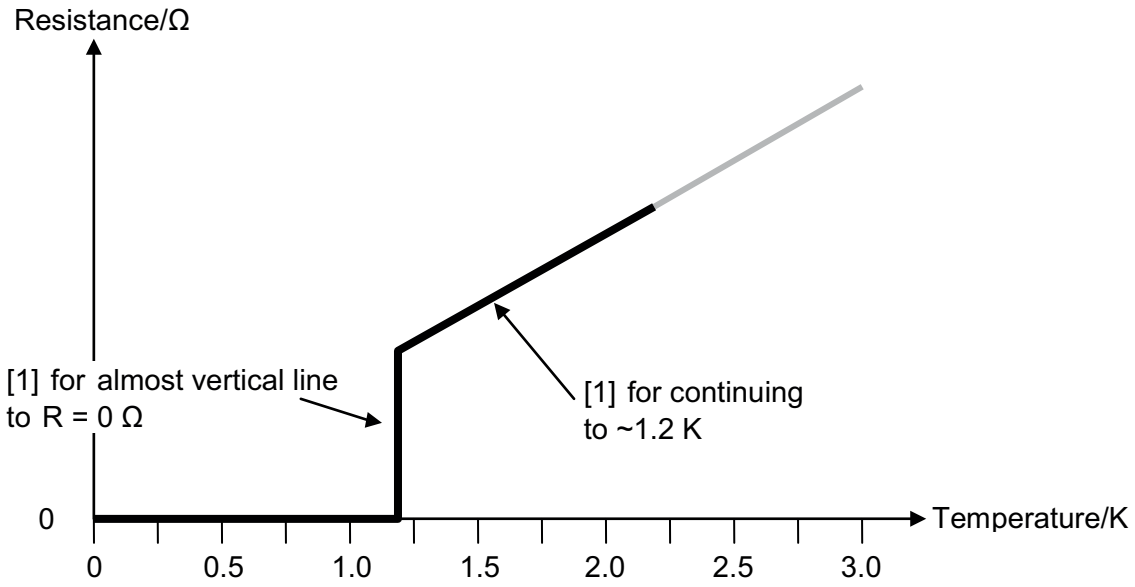
					AVAILABLE MARKS
8	(a)	(i)	$Q = 2.91 \times 10^{21} \times 1.6 \times 10^{-19}$ (must show values multiplied) **or** sub into Q = ne	[1]	
		(ii)	$I = \frac{\Delta Q}{\Delta t}$ Eqn [1]		
			$I \times \frac{466}{60}$ Subs + conversion [1]		
			$I = 7.77$ (A) [1]	[3]	
	(b)		$V = W/Q = 107 \times 10^3/466$ Eqn or subs [1]		
			$V = 230$ (V) [1]	[2]	6
9	(a)	(i)	Current (through*) and corresponding voltage (across*) measured		
			*either/or/both [1]		
			Stating $R = V/I$ [1]	[2]	
			(Use of ohmmeter [1] across wire [1])		
		(ii)	Micrometer to measure diameter (determine radius) of wire [1]		
			Equation to calculate A consistent with radius/diameter as above [1]	[2]	

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]

				AVAILABLE MARKS
(b)	**(i)**			
		Fig 9.1	[2]	
	(ii)	Superconduction	[1]	
	(iii)	**No** heat energy is generated	[1]	10
10	**(a)**	**(i)** $I = V_{out}/R_1$	[1]	
		$I = V_{in}/(R_1 + R_2)$ **or** $I = \frac{V_{in} - V_{out}}{R_2}$	[1]	[2]
	(ii)	$\frac{V_{out}}{V_{in}} = 0.625 = \frac{500}{500 + R_2}$	[1]	
		$R_2 = 300\ (\Omega)$	[1]	[2]
	(b)	$I_Y + I_Z = 96$ mA $I_Z = 3I_Y$ or current splits 4 ways etc. } Independent $I_Z = 72$ (mA)	[1] [1] [1]	[3] 7
			Total	**75**