Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2013

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

THURSDAY 13 JUNE, AFTERNOON

MARK SCHEME

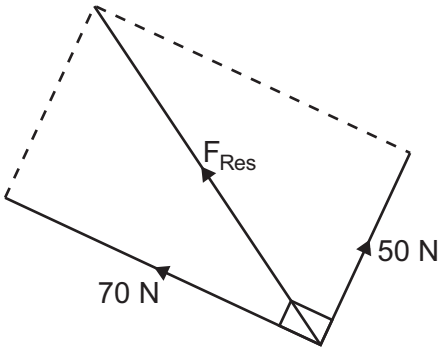
Subject-specific Instructions

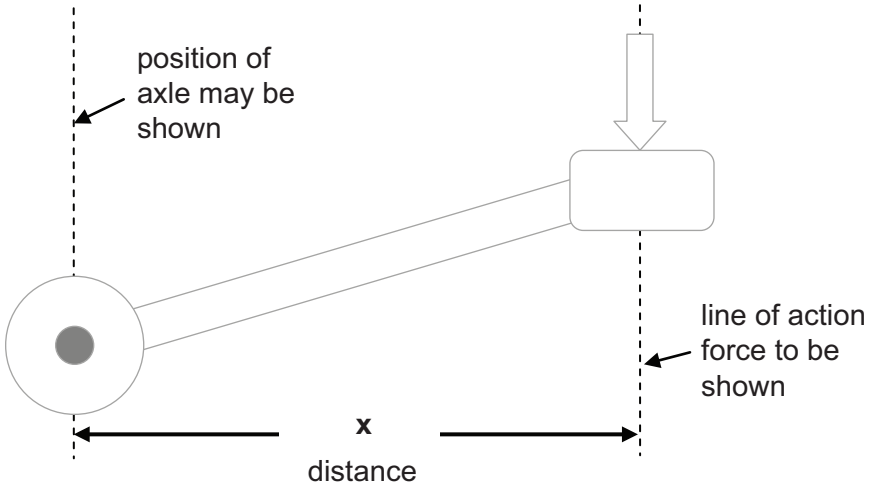
In numerical problems, the marks for the intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the final correct answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It 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.

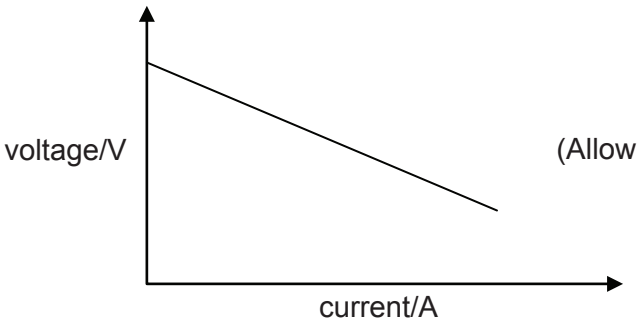
Do not reward wrong physics. No credit is given for consistent substitution of numerical data, or subsequent arithmetic, **in a physically incorrect equation**. However, answers to subsequent stages of questions that are consistent with an earlier incorrect numerical answer, and are based on physically 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)**	Scalar quantity as direction is NOT important **or** both work and time are scalars		[1]		
	(b)	**(i)** Drawing resultant (allow if correct in **(ii)**)		[1]		
		(ii) By calculation: $F_{Res} = (50^2 + 70^2)^{\frac{1}{2}}$ $F_{Res} = 86$ (N)		[1] [1]	[2]	
		or by scale drawing:	Completing construction F_{Res} = 82–90 (N)	[1] [1]		
						
		(iii) $\theta = \tan^{-1}(50/70)$ θ = 36 (35.5)°		[1] [1]	[2]	
		or Marking the correct angle on the construction θ = 33–39°		[1] [1]		
	(c)	East 39(.4) km North 50(.4) km		[1] [1]	[2]	8
2	**(a)**	**(i)** Acceleration = gradient of v–t graph e.g. a = (17.5 – –21)/6.0 a = –6.4 to –7.1 ($m s^{-2}$) – must be **negative**		[1] [1] [1]	[3]	
		(ii) Displacement = –12 m read directly from **Fig. 2.1**		[1]		
		Displacement (0 s–2.8 s) = $\frac{1}{2}(17.5 \times 2.8) = 24.5$ m Displacement (2.8 s–6.0 s) = $\frac{1}{2}(-21 \times 3.2) = -33.6$ m Total displacement = 24.5 + –33.6 = –9.1 Allow correct **use** of Eqns of motion		[1] [1] [1]		
		% diff = 100 × (12 – 9.1)/12 = 24%		[1]	[5]	
	(b)	**(i)** y-axis scale; regular and encompassing 2.4 m Linear from (0,0) to (6.0, 2.4)		[1] [1]	[2]	
		(ii) Linear from (0, 0.4) to (t $\geqslant$ 6s, 0.4)		[1]		11

						AVAILABLE MARKS
3	**(a)**	**(i)**	The product of a force and distance moved in the **direction** of the force	[1]		
		(ii)	F = 240 sin 28	[1]		
			F = 110 N (112.7 N)	[1]	[2]	
		(iii)	W = 4056 (J) ecf	[1]		
	(b)		GPE = 78 × 19.5 × 9.81	[1]		
			KE = 0.9 GPE (or equivalent)	[1]		
			v = 19 ($m\,s^{-1}$)	[1]	[3]	7
4	**(a)**		Force × **perpendicular** distance from the point	[1]		
	(b)	**(i)**				
			Either construction line(s)	[1]		
			Distance	[1]	[2]	
		(ii)	Angle 0° corresponds to the pedal **vertical** with the foot pad at the **top**	[1]		
			Moment increases as perpendicular distance (**not** angle) from pivot increases	[1]		
			to a maximum (when horizontal) then decreases to zero (vertical)	[1]		
			no force exerted during second half (don't want opposite directional sense)	[1]	[4]	
		(iii)	Maximum moment = 18 (N m)	[1]		
			18 (N m) = F × 0.22	Eqn or subs [1]		
			F = 82 (81.8) (N)	[1]	[3]	10

						AVAILABLE MARKS
5	**(a)**	**(i)**	(Wire) secured at one end and means of varying tension at the other [1] Means of measuring extension [1]			
		(ii)	Procedure: vary tension and measure corresponding extension [1] **Load** values Diameter of wire using micrometer **Unstretched** length of wire consistent with arrangement Extensions – detail appropriate to diagram [$\frac{1}{2}$] each, round down [2]			
		(iii)	Goggles (breaking wire under tension), for example	[1]	[6]	
	(b)		Graph (F v x or σ v ε) [1] Consistent analysis to obtain E (or calculation [1] and average [1]) [1]		[2]	
			Must see knowledge of $E = \frac{FL}{Ax}$ for full marks – failure to [–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]	10
6	**(i)**		$I = \Delta Q/\Delta t$ Eqn [1] $I = (4.11 \times 10^{21} \times 1.60 \times 10^{-19})/126$ Subs [1] (I = 5.22 A)		[2]	
	(ii)		P = IV Eqn [1] P = 5.22 × 230 Subs [1] P = 1.2 (kW) Ans [1]		[3]	
	(iii)		E = Pt (= VQ) Eqn [1] E = 1200 × 126 (= 230 × 4.11 × 10^{21} × 1.60 × 10^{-19}) Subs [1] E = 1.51 × 10^5 (J) Ans [1]		[3]	8

						AVAILABLE MARKS
7	**(i)**	Ammeter, voltmeter and variable resistor symbols correct		[1]		
		Components in correct positions		[1]	[2]	
	(ii)		Axes labels/units Best-fit line	[1] [1]	[2]	
			(Allow P v R graph for [2]/[2])			
	(iii)	(Measure the) gradient **or** Max P		[1]		
		Multiply gradient by –1 R = r		[1]	[2]	6
8	**(i)**	$V_{Rm} = 1.64 – V_{2.69\Omega}$	Eqn	[1]		
		$V_{Rm} = 1.64 – (0.425 \times 2.69)$	Subs	[1]		
		($V_{Rm} = 0.5$ V)			[2]	
	(ii)	$I_{Rm} = 425 – I_{3.17\Omega}$	Eqn	[1]		
		($I_{Rm} = 425 –$) 500/3.17 = 158 mA		[1]		
		($I_{Rm} = 267$ mA [2])				
		$R_m = \frac{0.5}{267 \times 10^{-3}} = 1.87(\Omega)$		[1]	[3]	
	(iii)	$R = \rho l/A$	Eqn	[1]		
		$1.87 = 2.35\ \rho/(\pi(0.846 \times 10^{-2}/2)^2)$				
		ecf **(ii)** or $A = 5.62 \times 10^{-7}$ m^2	Subs	[1]		
		$\rho = 4.47 \times 10^{-7}$ (Ω m)	Ans	[1]	[3]	8
9	**(a)**	Charge carrier density increases with temperature		[1]		
		Dominates resistance increase due to lattice vibration		[1]	[2]	
	(b)	**(i)** $6 = 14\ R_1/(R_1 + 3180)$	Subs	[1]		
		$R_1 = 2385$ (Ω)		[1]	[2]	
		(ii) $R_1 = 960$ (Ω) or 954 (Ω) ecf		[1]		
		$6 = 14 \times 960/(960 + R_v)$		[1]		
		$R_v = 1280$ (Ω) (1266 Ω)		[1]	[3]	7
				Total		**75**