Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2016

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

MONDAY 20 JUNE, 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.

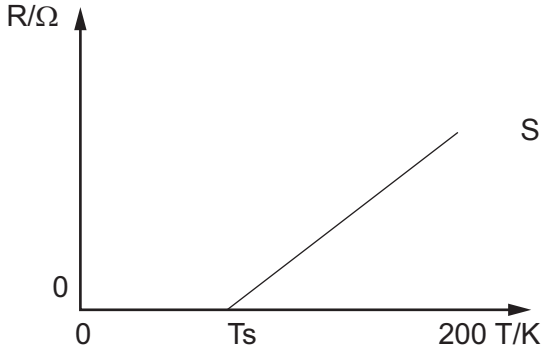
Note that this "correct answer" rule does not apply for formal proofs and derivations, which must be valid in all stages to obtain full credit.

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.

					AVAILABLE MARKS
1	**(a)**	mass, kg volume, m^3 temperature, K time, s [1] each row	No multiple answers	[4]	
	(b)	force in kg m s^{-2} or energy in kg m^2 s^{-2} [1] kg m^2 s^{-3} (be generous with format) [1]		[2]	6
2	**(a)**	use $s = \frac{1}{2}gt^2$ [1] correct calculation for one data set 9.60/10.13 m s^{-2}/10.32/10.6 [1] two calculations and average 9.87 m s^{-2} [1] S: 4.93 [1]/[3]		[3]	
	(b)	**metre** rule and (electronic) timer		[1]	
	(c)	distance not measured from base of sphere or valid alternative, e.g. reaction time, parallax error, air resistance Don't accept generalised statements		[1]	5
3	**(a)**	**(i)** $T_{vertical} = 2 \times v \sin 50/g$ [2], [1] if not doubled (independent) or S = 0m $T_{horizontal} = 18/v \cos 50$ [1] Penalty [–1] mixing vertical and horizontal		[3]	
		(ii) equated T values [1] working correct to show v = 13.4 m s^{-1} [1] Allow alternatives using range formula		[2]	
	(b)	answer 2.09 s (no e.c.f.)		[1]	6
4	**(a)**	(resultant) force proportional to rate of change of momentum or proportional to acceleration of a constant mass [1] and in same direction [1]		[2]	
	(b)	**(i)** mg = 579 N		[1]	
		(ii) mg + ma [1] 579 + (59 × 2.2) = 708.8 N e.c.f. from **(i)** [1] when lift decelerating – independent marking [1] (S 726.5 N → [1]/[3])		[3]	
	(c)	if lift falls freely or accelerates downwards at 9.81 m s^{-2} [1] then **zero** reaction from floor [1]		[2]	8
5	**(a)**	**(i)** CM = 124 × 70 (= 8680) [1] ACM = W × 20 [1] W = 434 N [1]		[3]	
		(ii) (upward = downward), 558 N e.c.f. **(i)**		[1]	
	(b)	supports moved further apart/towards ends of beam [1] the moment provided by the weight of the beam is increased [1] to allow greater moment in opposite direction before rotation occurs [1] or valid alternative for explanation marks.		[3]	7

						AVAILABLE MARKS
6	**(a)**	**(i)**	KE = $\frac{1}{2}$ mv^2 (= 0.5 × 0.8 × 22.11^2)	[1]		
			195.54 J	[1]	[2]	
		(ii)	additional E_p = mgΔh = 15.85 J	[1]		
			E_k = 211.39 J e.c.f. KE and e.c.f. Ep	[1]		
			Independent 92% of energy = 194.48 J	[1]	[3]	
			S_1 = 280 J [2] S_2 = 265 J [2] S_3 = 180 J [1]			
	(b)		work = F × d **or** KE = $\frac{1}{2}$ mv^2, v^2 = u^2 + 2as, F = ma	[1]		
			F = 3769 (N)	[1]	[2]	7
7	**(a)**		wire clamped at one end, means of varying tension at the other end	[1]		
			extension measurement at appropriate point (> half distance)	[1]	[2]	
	(b)		extension measured for (a range of) forces	[1]		
			length of wire with (metre) rule (clamp to pointer)	[1]		
			extension with ruler/vernier	[1]		
			diameter of wire with micrometer gauge	[1]	[4]	
	(c)		graph F v x or Stress v Strain	[1]		
			gradient of graph used to calculate E	[1]		
			evidence of E = Fl/Ax or $\sigma = \frac{F}{A}$ and $E = \frac{x}{l}$	[1]	[3]	
			Non graph – multiple calculations and average [2]			
			calculation + equation once [1]			
			repeat + average [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. 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]		11
8	**(a)**	**(i)**	rate of flow of charge		[1]	
		(ii)	energy transferred from electrical (to other forms)	[1]		
			per coulomb	[1]	[2]	
	(b)	**(i)**	Q = I × t (= 0.025 × 120) [1] eqn. = 3 C [1]		[2]	
		(ii)	W (= Q × V = 3 × 6) = 18 J e.c.f. **(i)**		[1]	6

					AVAILABLE MARKS
9	**(a)**	For (an ohmic) (conductor) at constant temperature [1] current and p.d. are proportional [1]		[2]	
	(b)	**(i)** $R = V/I = 6/0.002 = 3000\ \Omega$		[1]	
		(ii) $(1/2R + 1/R)^{-1} + R = 3000$ [2] e.c.f. **(i)** (expression for parallel arrangement [1]) $R = 1800\ \Omega$ [1]		[3]	6
10	**(a)**	$\rho = R.A/l$ [1] $\rho = R.\pi d^2/4l$ [1]		[2]	
	(b)	**(i)** Gradient of graph or data from graph [1]			
		Calculating a correct d value (0.36 mm or 6×10^{-5}m) [1]			
		Realising $\left\vert \begin{matrix} 0.06\,\text{mm} \\ 3 \times 10^{-9}\text{m}^2 \end{matrix} \right\vert$ is too small and stating the wire is nichrome [1]		[3]	
		(ii) low current through the wire or low voltage		[1]	6
11	**(a)**	Superconductors lose all their resistivity/have **zero** resistance [1] below a certain **critical/transition** temperature [1]		[2]	
	(b)	T_s at approx. 92K [1] (almost) vertical line at T_s [1] straight line with positive gradient up to 200K (or slight curve) [1]		[3]	
		 S = [1] only if T_s is correct			
	(c)	for application [1] extremely strong magnetic fields produced [1]		[2]	7
			Total		**75**