New Specification

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Physics

Assessment Unit AS 1

assessing

Forces, Energy and Electricity

[SPH11]

TUESDAY 23 MAY, 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)**	Q = It or subs	[1]		
		486 C SE : 8.1 scores [1]/[2]	[1]	[2]	
	(b)	**(i)** Energy per coulomb/joule per unit charge (one unit)	[1]		
		1 joule per coulomb	[1]	[2]	
		(ii) E = VQ or IVt or subs	[1]		
		2916 J ecf from **(a)**	[1]	[2]	6
2	**(a)**	$R = \frac{V}{I}$	[1]		
		Calculates R correctly for any values 17.8 / 18.4 / 18.1	[1]		
		Averages correctly to 18 (18.1) Ω	[1]	[3]	
	(b)	**(i)** Resistance of 1 m length/unit length	[1]		
		And 1 m^2 CSA/unit CSA	[1]	[2]	
		Doesn't depend on the dimensions/size of the sample/a property of a particular material	[1]		
		(ii) $R = \frac{\rho l}{A}$	[1]		
		$A = 1.21 \times 10^{-4}$	[1]		
		4.1×10^{-2} (Ωm)	[1]		
		Volume of putty = 6.41×10^{-6} m^3 (any unit)	[1]		
		New CSA = 1.03×10^{-4} or new d = 1.15×10^{-2} m	[1]		
		R = 24.7 Ω (ecf from ρ value)	[1]	[6]	12
3	**(a)**	Equilibrium	[1]		
		Sum of clockwise moments = sum of anticlockwise moments	[1]		
		Around (same) point	[1]	[3]	
	(b)	**(i)** Find the point where it balances		[1]	
		(ii) $f_1 x = f_2$ (dist – x)	[1]		
		$58(30 - x) = 50(x - 15) + 25x$	[1]		
		18.7 cm	[1]	[3]	7
4	**(a)**	Base units of v $m s^{-1}$	[1]		
		Base units of ρ $kg m^{-3}$	[1]		
		Rearranges to kg m^{-1} s^{-2}	[1]	[3]	
	(b)	**(i)** 1.82×10^6			
		Number correct [1], 10^n correct [1]		[2]	
		(ii) 25.2		[1]	6

					AVAILABLE MARKS
5	**(a)**	Velocity will decrease (uniformly)	[1]		
		Direction stays the same	[1]		
		Displacement will increase (at a slower rate)	[1]		
		Direction stays the same	[1]	[4]	
	(b) **(i)**	Tangent drawn at t = 10	[1]		
		Calculates gradient	[1]		
		Value correct from their gradient (1.5–2.5 quality)	[1]	[3]	
	(ii)	Dist = area under graph	[1]		
		960 –1150 m	[1]		
		4100 – their calculated distance	[1]	[3]	10
6	**(a)**	Valid equation of motion quoted	[1]		
		Measurements to input depending on equation	[1]		
		Detail of calculations from software	[1]		
		Time qualified/time through gate u = 0	[1]	[4]	
	(b)	Air resistance	[1]		
		Explanation – increased time taken to fall giving smaller g value or equivalent/falls slower/reduced speed	[1]	[2]	6
7	**(a)** **(i)**	Pe = mgh or subs	[1]		
		1.53 m	[1]	[2]	
	(ii)	ke = $\frac{1}{2}mv^2$	[1]		
		5.48 m s^{-1} or 4.83 m s^{-1}	[1]		
		0.65 m s^{-1}	[1]	[3]	
		SE: v calculated from ΔE = 2.58 scores [1]/[3]			
	(b) **(i)**	P = $\frac{E}{t}$	[1]		
		Correct subs or 7222 s	[1]		
		2.01 h ecf s → hours	[1]	[3]	
	(ii)	Uses efficiency equation	[1]		
		Calculates E input correctly 1.38 × 10^8 (E out = 3.58 × 10^7)	[1]		
		Calculate number of litres of oil 3.63	[1]		
		Calculates cost per day £1.05	[1]		
		£7.35	[1]	[5]	
		Ecf at each stage (also rounding differences)			
	(iii)	E.g. Saving energy resources/less greenhouse gas emission/ reduce waste energy/less pollution		[1]	14

					AVAILABLE MARKS
8	**(a)**	A body will remain at rest or continue to move with constant velocity unless acted on by a **resultant** force	[1]		
		The acceleration of a body is proportional to the **resultant** force on it, inversely proportional to the mass and in the direction of the force	[1]		
		When one body exerts a force on another the second body exerts an equal and opposite force on the first	[1]	[3]	
	(b)	Raft at rest – no resultant force/upthrust = weight	[1]		
		The raft accelerates because there is a resultant force on it Accept correct momentum description	[1]		
		Force on man from raft is equal and opposite to force on raft from man so raft moves in opposite direction to the man	[1]	[3]	6
		Resistive force causes raft to decelerate R force towards shore			
9	**(a)**	Variable resistor	[1]		
		Ammeter and voltmeter ([–1] for additional fixed resistor)	[1]	[2]	
	(b)	Values of V and I	[1]		
		Adjust using variable resistor	[1]		
		At least 5 sets of readings	[1]		
		Plot V against I	[1]		
		– Gradient = r	[1]	[5]	7
10	**(a)**	Resistance decreases	[1]		
		(As temp increases) more charge carriers are released	[1]	[2]	
	(b)	**(i)** Bulb will light at low temperature	[1]		
		Because voltage across thermistor is higher at low temp	[1]	[2]	
		(ii) $5.5 = \frac{R(9)}{R + 1.2(x10^3)}$	[1]		
		1.9 kΩ (1.89)	[1]		
		ecf $\frac{1}{1.9} = \frac{1}{2.2} + \frac{1}{R}$	[1]		
		R = 13.9 kΩ (Rounding differences → 13.2)	[1]	[4]	
		Alternative:			
		Current through resistor = $\frac{3.5}{1.2}$ = 2.92 (mA)	[1]		
		Current through bulb = $\frac{5.5}{2.2}$ = 2.50 (mA)	[1]		
		Current through thermistor = 2.92 – 2.50 = 0.42 (mA)	[1]		
		Resistance of thermistor = $\frac{5.5}{0.42}$ = 13.1 (kΩ)	[1]		8
11	**(a)**	Zero force in the horizontal direction or air resistance	[1]		
		Constant force in a (perpendicular) vertical direction	[1]	[2]	
	(b)	Horizontal 8.70 = 9.84 Cos 50t	[1]		
		T = 1.38 s	[1]		
		Vertical uses s = ut + $\frac{1}{2}$at^2	[1]		
		1.06 m ecf T	[1]		
		3.02 m ecf s	[1]	[5]	7

					AVAILABLE MARKS
12	**(a)**	Uses conservation of momentum – mv product on both sides of equation	[1]		
		$6780(96) = 6730(8.2) + 50v$	[1]		
		$11.9\ km\ s^{-1}$	[1]	[3]	
	(b)	**(i)** Impulse/change in momentum = $F\Delta t$	[1]		
		Airbag increases t	[1]		
		Decreases F	[1]	[3]	
		(ii) $5750(8.2) = 44 \times 10^3 t$	[1]		
		1.1 s	[1]	[2]	8
13	W = 196 N		[1]		
	F = 260 N		[1]		
	49°		[1]	[3]	3
				Total	**100**