CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

9702/22 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1	**(a)**	kelvin / K	B1	
		ampere / amp / A	B1	[2]
		[allow mole / mol and candela / Cd]		
	(b) (i)	energy OR work = force × distance [allow any energy expression]	C1	
		units: kg m s^{-2} × m OR kg $(m\,s^{-1})^2$ for ½ mv^2 or mc^2 (ignore any numerical factor)	M1	
		= kg m^2 s^{-2}	A0	[2]
	(ii)	units: ρ: kg m^{-3} g: m s^{-2} A: m^2 l_0: m	C1	
		C: kg m^2 s^{-2} / kg^2 m^{-6} m^2 s^{-4} m^2 m^3 [any subject]	C1	
		= kg^{-1} m s^2 (allow m s^2 / kg)	A1	[3]
2	**(a)**	$d = v \times t$	C1	
		$t = 0.2 \times 4$ (allow $t = 0.2 \times 2$)	C1	
		$d = 3 \times 10^8 \times 0.8 \times 10^{-6}$ OR $3 \times 10^8 \times 0.4 \times 10^{-6}$	C1	
		d = 240 m hence distance from source to reflector = 120 m	A1	[4]
	(b)	speed of sound 300 cf speed of light 3×10^8 OR time = 240 / 300 (= 0.8) OR time = 120 / 300 (= 0.4)	C1	
		sound slower by factor of 10^6 OR time for one division 0.8 / 4 OR time for one division 0.4 / 2	C1	
		time base setting 0.2 s cm^{-1} [unit required]	A1	[3]
3	**(a)**	(work =) force × distance <u>moved</u> / displacement in the direction of the force OR when a force moves in the direction of the force work is done	B1	[1]
	(b)	kinetic energy = ½ mv^2	C1	
		= <u>½ 0.4 $(2.5)^2$ = 1.25 / 1.3 J</u>	A1	[2]
	(c) (i)	area under graph is work done / work done = ½ Fx	C1	
		1.25 = (14 x) / 2	C1	
		x = 0.18 (0.179) m [allow x = 0.19 m using kinetic energy = 1.3 J]	A1	[3]
	(ii)	smooth curve from v = 2.5 at x = 0 to v = 0 at Q	M1	
		curve with increasing gradient	A1	[2]

4	**(a)**		torque of a couple = one of the forces / a force × distance	M1	
			multiplied by the perpendicular distance between the forces	A1	[2]
	(b)	**(i)**	weight at P (vertically) down	B1	
			normal reaction OR contact force at (point of contact with the pin) P (vertically) up	B1	[2]
		(ii)	torque = 35 × 0.25 (or 25) × 2	C1	
			= 18 (17.5) N m	A1	[2]
		(iii)	the two 35 N forces are equal and opposite and the weight and the upward / contact / reaction force are equal and opposite	B1	[1]
		(iv)	not in equilibrium as the (resultant) torque is not zero	B1	[1]
5	**(a)**	**(i)**	displacement is the distance the rope / particles are (above or below) from the equilibrium / mean / rest / undisturbed position (not ‘distance moved’)	B1	[1]
		(ii)	**1.** amplitude (= 80 / 4) = 20 mm	B1	[1]
			2. $v = f\lambda$ or $v = \lambda / T$	C1	
			$f = 1 / T = 1 / 0.2$ (5 Hz)	C1	
			$v = 5 \times 1.5 = 7.5\ \mathrm{m\,s^{-1}}$	A1	[3]
	(b)		point A of rope shown at equilibrium position	B1	
			same wavelength, shape, peaks / wave moved ¼λ to right	B1	[2]
	(c)	**(i)**	progressive as energy OR peaks OR troughs is/are transferred/moved /propagated (by the waves)	B1	[1]
		(ii)	transverse as particles/rope movement is perpendicular to direction of travel /propagation of the energy/wave velocity	B1	[1]
6	**(a)**		p.d. = work (done) / charge OR energy transferred from (electrical to other forms) / (unit) charge	B1	[1]
	(b)	**(i)**	$R = \rho l / A$	C1	
			$\rho = 18 \times 10^{-9}$	C1	
			$R = (18 \times 10^{-9} \times 75) / 2.5 \times 10^{-6} = 0.54\ \Omega$	A1	[3]
		(ii)	$V = IR$	C1	
			$R = 38 + (2 \times 0.54)$	C1	
			$I = 240 / 39.08 = 6.1\ (6.14)$ A	A1	[3]

(iii) $P = I^2R$ or $P = VI$ **and** $V = IR$ or $P = V^2/R$ **and** $V = IR$ C1
$= (6.14)^2 \times 2 \times 0.54$ C1
$= 41$ (40.7) W A1 [3]

(c) area of wire is less (1/5) hence resistance greater (×5) M1
OR R is $\propto 1/A$ therefore R is greater
p.d. across wires greater so power loss in cables increases A1 [2]

7 (a) (i) the direction of the fields is the same OR fields are uniform OR constant electric field strength OR $E = V / d$ with symbols explained B1 [1]

(ii) reduce p.d. across plates B1
increase separation of plates B1 [2]

(iii) α opposite charge to β (as deflection in opposite direction) B1
β has a range of velocities OR energies (as different deflections) and α all have same velocity OR energy (as constant deflection) B1
α are more massive (as deflection is less for greater field strength) B1 [3]

(b) $W = 234$ and $X = 90$ B1
$Y = 4$ and $Z = 2$ B1 [2]

(c) $A = 32$ and $B = 16$ and $C = 0$ and $D = -1$ B1 [1]