CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9702 PHYSICS

9702/23 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.

Cambridge will not enter into discussions about these mark schemes.

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

1	**(a)**		force: kg m s^{-2}	A1	[1]
	(b)	**(i)**	I^2: A^2 l: m x: m	C1	
			K: kg m s^{-2} A^{-2}	A1	[2]
		(ii)	curve of the correct shape (for inverse proportionality)	M1	
			clearly approaching each axis but never touching the axis	A1	[2]
		(iii)	curving upwards and through origin	A1	[1]
2	**(a)**	**(i)**	**1.** distance of path / along line AB	B1	[1]
			2. shortest distance between AB / distance in straight line between AB or displacement from A to B	B1	[1]
		(ii)	acceleration = rate of change of velocity	A1	[1]
	(b)	**(i)**	distance = area under line or $(v/2)t$ or $s = (8.8)^2 / (2 \times 9.81)$	C1	
			= 8.8 / 2 × 0.90 = 3.96 m or s = 3.95 m = 4(.0) m	A1	[2]
		(ii)	acceleration = (– 4.4 – 8.8) / 0.50	C1	
			= (–) 26(.4) m s^{-2}	A1	[2]
	(c)	**(i)**	the accelerations are constant as straight lines	B1	
			the accelerations are the same as same gradient or no air resistance as acceleration is constant or change of speed in opposite directions (one speeds up one slows down)	B1	[2]
		(ii)	area under the lines represents height or KE at trampoline equals PE at maximum height	B1	
			second area is smaller / velocity after rebound smaller hence KE less	B1	
			hence less height means loss in potential energy	A0	[2]
3	**(a)**	**(i)**	the total momentum of a system (of interacting bodies) remains constant	M1	
			provided there are no resultant external forces / isolated system	A1	[2]
		(ii)	elastic: total kinetic energy is conserved, inelastic: loss of kinetic energy [allow elastic: relative speed of approach equals relative speed of separation]	B1	[1]

	(b)	**(i)**	initial mom: 4.2 × 3.6 – 1.2 × 1.5 (= 15.12 – 1.8 = 13.3) final mom: 4.2 × v + 1.5 × 3 v = (13.3 – 4.5) / 4.2 = 2.1 m s^{-1}	C1 C1 A1	 [3]
		(ii)	initial kinetic energy = ½ $m_A(v_A)^2$ + ½ $m_B(v_B)^2$ = 27.21 + 1.08 = 28(.28) final kinetic energy = 9.26 + 6.75 = 16 initial KE is not the same as final KE hence inelastic *provided final KE less than initial KE* [allow in terms of relative speeds of approach and separation]	 M1 M1 A1	 [3]
4	**(a)**	**(i)**	stress = force / cross-sectional area	B1	[1]
		(ii)	strain = extension / <u>original</u> length	B1	[1]
	(b)	**(i)**	E = stress / strain E = 0.17 × 10^{12} stress = 0.17 × 10^{12} × 0.095 / 100 = 1.6(2) × 10^{8} Pa	C1 C1 C1 A1	 [4]
		(ii)	force = (stress × area) = 1.615 × 10^{8} × 0.18 × 10^{-6} = 29(.1) N	C1 A1	 [2]
5	**(a)**		when waves overlap / meet the resultant displacement is the sum of the individual displacements of the waves	B1 B1	 [2]
	(b)	**(i)**	**1.** phase difference = 180° / (n + ½) 360° (allow in rad)	B1	[1]
			2. phase difference = 0 / 360° / (n360°) (allow in rad)	B1	[1]
		(ii)	$v = f\lambda$ λ = 320 / 400 = 0.80 m	C1 A1	 [2]
		(iii)	path difference = 7 – 5 = 2 (m) = 2.5λ hence minimum or maximum if phase change at P is suggested	 M1 A1	 [2]
6	**(a)**		p.d. = $\frac{\text{work done / energy transformed}}{\text{charge}}$ (from electrical to other forms)	B1	[1]
	(b)	**(i)**	maximum 20 V	A1	[1]
		(ii)	minimum = (600 / 1000) × 20 = 12 V	C1 A1	 [2]

	(c)	**(i)**	use of 1.2 kΩ	M1	
			1/1200 + 1/600 = 1/*R*, *R* = 400 Ω	A1	[2]
		(ii)	total parallel resistance (R_2 + LDR) is less than R_2	M1	
			(minimum) p.d. is reduced	A1	[2]
7	**(a)**	**(i)**	nucleus contains 92 protons	B1	
			nucleus contains 143 neutrons (missing 'nucleus' 1/2)	B1	
			outside / around nucleus 92 electrons	(B1)	
			most of atom is empty space / mass concentrated in nucleus	(B1)	
			total charge is zero	(B1)	
			diameter of atom ~ 10^{-10} m or size of nucleus ~ 10^{-15} m	(B1)	
			any two of (B1) marks		[4]
		(ii)	nucleus has same number / 92 protons	B1	
			nuclei have 143 and 146 neutrons (missing 'nucleus' 1/2)	B1	[2]
	(b)	**(i)**	*Y* = 35	A1	
			Z = 85	A1	[2]
		(ii)	mass-energy is conserved in the reaction	B1	
			mass on rhs of reaction is less so energy is released explained in terms of $E = mc^2$	B1	[2]