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.

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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 B1 [1]
[allow elastic: relative speed of approach equals relative speed of separation]

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