

## **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:  $\text{kg m s}^{-2}$  A1 [1]
- (b) (i)  $I^2$ :  $\text{A}^2$   $l$ : m  $x$ : m  
 $K$ :  $\text{kg m s}^{-2} \text{A}^{-2}$  C1  
A1 [2]
- (ii) curve of the correct shape (for inverse proportionality)  
clearly approaching each axis but never touching the axis M1  
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  $s = (8.8)^2 / (2 \times 9.81)$   
 $= 8.8 / 2 \times 0.90 = 3.96 \text{ m}$  or  $s = 3.95 \text{ m} = 4(.0) \text{ m}$  C1  
A1 [2]
- (ii) acceleration =  $(-4.4 - 8.8) / 0.50$   
 $= (-) 26(.4) \text{ m s}^{-2}$  C1  
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  
provided there are no resultant external forces / isolated system M1  
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]

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- (b) (i) initial mom:  $4.2 \times 3.6 - 1.2 \times 1.5$  (= 15.12 – 1.8 = 13.3)  
final mom:  $4.2 \times v + 1.5 \times 3$   
 $v = (13.3 - 4.5) / 4.2 = 2.1 \text{ m s}^{-1}$  C1  
C1  
A1 [3]
- (ii) initial kinetic energy =  $\frac{1}{2} m_A (v_A)^2 + \frac{1}{2} m_B (v_B)^2$   
= 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 / original length B1 [1]
- (b) (i)  $E = \text{stress} / \text{strain}$  C1  
 $E = 0.17 \times 10^{12}$  C1  
stress =  $0.17 \times 10^{12} \times 0.095 / 100$  C1  
=  $1.6(2) \times 10^8 \text{ Pa}$  A1 [4]
- (ii) force = (stress  $\times$  area) =  $1.615 \times 10^8 \times 0.18 \times 10^{-6}$  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 =  $180^\circ / (n + \frac{1}{2}) 360^\circ$  (allow in rad) B1 [1]  
2. phase difference =  $0 / 360^\circ / (n360^\circ)$  (allow in rad) B1 [1]
- (ii)  $v = f\lambda$  C1  
 $\lambda = 320 / 400 = 0.80 \text{ m}$  A1 [2]
- (iii) path difference =  $7 - 5 = 2 \text{ (m)}$   
=  $2.5\lambda$  M1  
hence minimum  
or maximum if phase change at P is suggested A1 [2]
- 6 (a) p.d. = work done / energy transformed (from electrical to other forms)  
charge B1 [1]
- (b) (i) maximum 20 V A1 [1]
- (ii) minimum =  $(600 / 1000) \times 20$  C1  
= 12 V A1 [2]

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- (c) (i) use of  $1.2\text{ k}\Omega$  M1  
 $1/1200 + 1/600 = 1/R$ ,  $R = 400\Omega$  A1 [2]
- (ii) total parallel resistance ( $R_2 + \text{LDR}$ ) 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  $\sim 10^{-10}\text{ m}$  or size of nucleus  $\sim 10^{-15}\text{ m}$  (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]