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 $s = (8.8)^2 / (2 × 9.81)$ 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]

PMT

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(b) (i) initial mom: $4.2 \times 3.6 - 1.2 \times 1.5$ $(= 15.12 - 1.8 = 13.3)$ C1
final mom: $4.2 \times v + 1.5 \times 3$ C1
$v = (13.3 - 4.5) / 4.2 = 2.1\,\text{m s}^{-1}$ A1   [3]

(ii) initial kinetic energy $= \frac{1}{2}\, m_A (v_A)^2 + \frac{1}{2}\, m_B (v_B)^2$
$\quad\quad\quad\quad\quad\quad\quad\quad = 27.21 + 1.08 = 28(.28)$ 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
$E = 0.17 \times 10^{12}$ C1
stress $= 0.17 \times 10^{12} \times 0.095 / 100$ C1
$\quad\quad = 1.6(2) \times 10^8\,\text{Pa}$ A1   [4]

(ii) force = (stress × area) $= 1.615 \times 10^8 \times 0.18 \times 10^{-6}$ C1
$\quad\quad = 29(.1)\,\text{N}$ 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 $= 180° / (n + \frac{1}{2})\,360°$ (allow in rad)   B1   [1]

2. phase difference $= 0 / 360° / (n360°)$ (allow in rad)   B1   [1]

(ii) $v = f\lambda$ C1
$\lambda = 320 / 400 = 0.80\,\text{m}$ A1   [2]

(iii) path difference $= 7 - 5 = 2$ (m)
$\quad\quad\quad\quad\quad\quad = 2.5\lambda$ M1
hence minimum
or maximum if phase change at P is suggested   A1   [2]

6 (a) p.d. = <u>work done / energy transformed</u> (from electrical to other forms)
$\quad\quad\quad\quad\quad$ charge   B1   [1]

(b) (i) maximum 20 V   A1   [1]

(ii) minimum $= (600 / 1000) \times 20$ C1
$\quad\quad\quad = 12\,\text{V}$ A1   [2]

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(c) (i) use of $1.2\,k\Omega$ M1

        $1/1200 + 1/600 = 1/R$, $R = 400\,\Omega$ 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 $\sim 10^{-10}\,m$ or size of nucleus $\sim 10^{-15}\,m$ (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]