UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9702 PHYSICS

9702/21 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 must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

1   (a) (i)   metre rule / tape   (*not 'rule'*)

        (ii)   micrometer (screw gauge) / digital caliper   B1

        (iii) ammeter and voltmeter / ohmmeter / multimeter on 'ohm' setting   B1   [1]

    (b) (i)   resistivity = RA / L C1
                         = $[7.5 \times \pi \times (0.38 \times 10^{-3})^2 / 4] / 1.75$ M1
                         = 4.86×10^{-7} Ω m   A0   [2]

        (ii)   (uncertainty in R =) $[0.2 / 7.5] \times 100 = 2.7\%$
               <u>and</u> (uncertainty in L =) $[3 / 1750] \times 100 = 0.17\%$ C1
               (uncertainty in A =) $2 \times (0.01 / 0.38) \times 100 = 5.3\%$ C1
               total = 8.13%   C1

               uncertainty = 0.395×10^{-7} (Ω m)   A1   [4]
               (*missing 2 factor in uncertainty in A, then allow max 3/4*)

    (c) resistivity = $(4.9 \times 10^{-7} \pm 0.4 \times 10^{-7})$ Ω m   A1   [1]

2   (a) work done is the force × the distance moved / displacement in the direction of the
         force
         or
         work is done when a force moves in the direction of the force   B1   [1]

    (b) component of weight = $850 \times 9.81 \times \sin 7.5°$ C1
                              = 1090 N   A1   [2]
         (*use of incorrect trigonometric function, 0/2*)

    (c) (i) $\Sigma F = 4600 - 1090 = (3510)$ M1
               deceleration = 3510 / 850   A1
                            = 4.1 m s^{-2} A0   [2]

        (ii) $v^2 = u^2 + 2as$
               $0 = 25^2 + 2 \times - 4.1 \times s$ C1
               $s = 625 / 8.2$
                 = 76 m   A1   [2]
               (*allow full credit for calculation of time (6.05 s) & then s*)

        (iii) 1.   kinetic energy = $\frac{1}{2} mv^2$ C1
                               = $0.5 \times 850 \times 25^2$
                               = 2.7×10^5 J   A1   [2]

              2.   work done   = 4600×75.7
                               = 3.5×10^5 J   A1   [1]

        (iv)   difference is the loss in potential energy (*owtte*)   B1   [1]

3 (a) point where the weight of an object / gravitational force
may be considered to act

(b) product of the force and the <u>perpendicular</u> distance (to the pivot)   B1   [1]

(c) (i) 1. sum / net / resultant force is zero   B1

     2. net / resultant moment is zero
        sum of clockwise moments = sum of anticlockwise moments   B1   [2]

(ii) $W \times 0.2 = 80 \times 0.5 + 70 \times 1.3$ C1
          $= 40 + 91$ C1
   W $= 655$ N   A1   [3]
   (*allow 2/3 for one error in distance but 0/3 if two errors*)

(iii) move pivot to left   (M1)
   gives greater clockwise moment / smaller
   anticlockwise moment   (A1)
   or
   move W to right   (M1)
   gives smaller anticlockwise moment   (A1)   [2]

4 (a) (i) *stress* is force / area   B1   [1]

(ii) *strain* is extension / <u>original</u> length   B1   [1]

(b) (i) $E = [F / A] \div [e / l]$ C1
   $e = (25 \times 1.7) / (5.74 \times 10^{-8} \times 1.6 \times 10^{11})$ C1
   $e = 4.6 \times 10^{-3}$ m   A1   [3]

(ii) A becomes $A/2$ or stress is doubled   B1
   $e \propto l / A$ or substitution into full formula   B1
   total extension increase is $4e$ A1   [3]

5 (a) (i) $I = 12 / (6 + 12)$ C1
   minimum current = 0.67 A   A1   [2]

(ii) correct start and finish points   M1
   correct shape for curve with decreasing gradient   A1   [2]

(b) maximum current = 2.0 A   A1
   minimum current = 0   A1   [2]

(c) (i) smooth curve starting at (0,0) with decreasing gradient   M1
   end section not horizontal   A1   [2]

(ii) full range of current / p.d. possible
   or   currents / p.d. down to zero
   or   brightness ranging from off to full brightness   B1   [1]

6 (a) any two of:
    large number of molecules / atoms / particles
    molecules in random motion
    no intermolecular forces
    elastic collisions
    time of collisions much less than time between collisions
    volume of molecules much less than volume of containing vessel   B1 + B1   [2]

(b) molecules collide with the walls
    change in momentum of molecules implies force (on molecules)
    molecules exert equal and opposite force on wall
    pressure is averaging effect of many collisions
    (*any three statements, 1 each*)   B3   [3]

7 (a) when waves overlap / meet, (resultant) displacement is the sum of the individual
    displacements   B1   [1]

(b) (i) two (ball-type) dippers   (M1)
    connected to the same vibrating source /motor   (A1)
    or
    one wave source described   (M1)
    with two slits   (A1)   [2]

    (ii) lamp with viewing screen on opposite side of tank   B1
    means of freezing picture e.g. strobe   B1   [2]

(c) (i) two correct lines labelled X   B1   [1]

    (ii) correct line labelled N   B1   [1]