UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9702 PHYSICS

9702/02   Paper 2 (AS Structured Questions), maximum raw mark 60

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Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9702	02

1 **(a)** systematic: e.g.   constant error (in all readings)
                              cannot be eliminated by averaging
                              error in measuring instrument   **B1**
       random: e.g.   readings scattered (equally) about true value
                              error due to observer
                              can be eliminated by averaging
                              (*only if averaging not included for systematic*)   **B1**   [2]

    (b) $15 = \pi \times R^2 \times 20$
        $R = 0.4886$ cm (accept any number of s.f.)   **C1**
        % uncertainty in V = 3.3 % (or 0.5/15)   **C1**
        % uncertainty in L = 0.5 % (or 0.1/20)   **C1**
        % uncertainty in R = 1.9 % (i.e. one half of the sum)   **C1**
        $R = 0.489 \pm 0.009$ cm   **A1**   [5]

2 **(a)** 3.5 T **B1**   [1]

    (b) (i) distance = average speed × time (however expressed)   **C1**
                       = 14 m   **A1**   [2]

        (ii) distance = 5.6 × (T – 5)   (*or 3.5T – 14*)   **A1**   [1]

    (c) 3.5T = 14 + 5.6(T – 5)   **C1**
        T = 6.7 s   **A1**   [2]

    (d) (i) acceleration = (5.6 / 5 =) 1.12 m s^{-2} **C1**
           force   = ma **C1**
                = 75 N   **A1**   [3]

        (ii) power = (force × speed =) {75 + 23} × 4.5   **C1**
                    = 440 W   **A1**   [2]
           (*allow 1/2 for 234 W, 0/2 for 338 W or 104 W*)

3 **(a) (i)** potential energy: stored energy available to do work   **B1**   [1]

        (ii) gravitational: due to height/position of mass OR distance from mass
                                OR moving mass from one point to another   **B1**
           elastic: due to deformation/stretching/compressing   **B1**   [2]

    (b) (i) height raised = (61 – {61 cos18} =) 3.0 cm   **C1**
          energy = (mgh = 0.051 × 9.8 × 0.030 =) 1.5 × 10^{-2} J   **A1**   [2]

        (ii) moment = force × perpendicular distance
                    = 0.051 × 9.8 × 0.61 × sin18   **C1**
                   = 0.094 N m   **A1**   [2]

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Page 3	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9702	02

4 **(a)** brittle   B1   [1]

    (b) Young modulus = stress / strain   C1
                  = (9.5×10^8) / 0.013
                  = 7.3×10^{10} Pa (*allow $\pm 0.1 \times 10^{10}$ Pa*)   A1   [2]

    (c) stress = force / area   C1
        (minimum) area = (1.9×10^3) / (9.5×10^8)
                     = 2.0×10^{-6} m^2 C1
        (max) area of cross-section = $(3.2 - 2.0) \times 10^{-6}$
                     = 1.2×10^{-6} m^2 A1   [3]

    (d) when bent, 'top' and 'bottom' edges have different extensions   M1
        with thick rod, difference is greater (than with a thin rod)   A1
        so breaks with less bending   A0   [2]

5 **(a)** amplitude between 6.5 squares and 7.5 squares on 3 peaks   B2
        (*allow 1 mark if outside this range but between 6.0 and 8.0 squares*)
        correct phase (ignore lead/lag, look at x-axis only and allow $\pm\frac{1}{2}$ square   B1   [3]

    (b) $\lambda = ax$ / D C1
        540×10^{-9} = $(0.700 \times 10^{-3} x)$ / 2.75   C1
        x = 2.12 mm   A1   [3]

    (c) **(i)** same separation   B1
            bright areas brighter (1)
            dark areas, no change (1)
            (*allow 'contrast greater' for 1 mark if dark/light areas not discussed*)
            fewer fringes observed (1)   *any two, 1 each*   B2   [3]

        (ii) smaller separation of fringes   B1
            no change in brightness   B1   [2]

6 **(a)** power = VI C1
        current = 10.5×103 / 230   M1
            = 45.7 A   A0   [2]

    (b) **(i)** p.d. across cable = 5.0 V   C1
            R = 5.0 / 46   C1
              = 0.11 Ω A1   [3]

        (ii) $R = \rho L$ / A C1
            0.11 = $(1.8 \times 10^{-8} \times 16 \times 2)$ / A C1
            A = 5.3×10^{-6} m^2 A1   [3]
            (*wires in parallel, not series, allow max 1/3 marks*)

Page 4	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9702	02

(c) (i) *either* power = V^2 / R *or* power $\propto V^2$ C1
ratio = $(210 / 230)^2$ = 0.83   A1   [2]

    (ii) resistance of cable is greater   M1
greater power loss/fire hazard/insulation may melt
wire may melt/cable gets hot   A1   [2]

7 (a) most α-particles deviated through small angles   B1
(*accept 'undeviated'*)
few α-particles deviated through angles greater than 90°   B1   [2]

(b) (i) allow 10^{-9} m $\rightarrow 10^{-11}$ m   B1   [1]

    (ii) allow 10^{-13} m $\rightarrow 10^{-15}$ m   B1   [1]
(*if (i) and (ii) out of range but (ii) = 10^{-4}(i), then allow 1 mark*)
(*if no units or wrong units but (ii) = 10^{-4}(i), then allow 1 mark*)