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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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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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]

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

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

(c) stress = force / area C1
(minimum) area = $(1.9 \times 10^3) / (9.5 \times 10^8)$
= 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 ±½ square B1 [3]

(b) $\lambda = ax / D$ C1
$540 \times 10^{-9} = (0.700 \times 10^{-3}\ x) / 2.75$ 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 = $10.5 \times 103 / 230$ 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*)

(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*)