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

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.

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*)