UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary and Advanced Level

MARK SCHEME for the June 2005 question paper

9702 PHYSICS

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

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. This shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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Grade thresholds for Syllabus 9702 (Physics) in the June 2005 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 2	60	43	39	26

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

June 2005

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 60

SYLLABUS/COMPONENT: 9702/02

PHYSICS
Paper 2 (Structured)

UNIVERSITY of CAMBRIDGE
International Examinations

1 **(a)** allow 100 m s^{-1} → 900 m s^{-1} B1 **[1]**

(b) allow 0.5 kg m^{-3} → 1.5 kg m^{-3} B1 **[1]**

(c) allow 5 g → 50 g B1 **[1]**

(d) allow 2×10^3 cm^3 → 9×10^3 cm^3 B1 **[1]**

2 **(a)** speck of light B1
that moves haphazardly/randomly/jerkily/etc. B1 **[2]**

(b) randomness of collisions would be 'averaged out' B1
so less (haphazard) movement B1 **[2]**
(do not allow 'more massive so less movement')

3 **(a) (i)** $\Delta E_p = mg\Delta h$ C1
$= 0.602 \times 9.8 \times 0.086$
$= 0.51$ J A1 **[2]**
(do not allow g = 10, m = 0.600 or answer 0.50 J)

(ii) $v^2 = (2gh =) 2 \times 9.8 \times 0.086$ <u>or</u> (2 x 0.51)/0.602 M1
$v = 1.3$ (m s^{-1}) A0 **[1]**

(b) $2 \times V = 602 \times 1.3$ (allow 600) C1
$V = 390$ m s^{-1} A1 **[2]**

(c) (i) $E_k = ½mv^2$ C1
$= ½ \times 0.002 \times 390^2$
$= 152$ J or 153 J or 150 J A1 **[2]**

(ii) E_k not the same/changes
<u>or</u> E_k before impact>E_k after/E_p after M1
so must be inelastic collision A1 **[2]**
(allow 1 mark for 'bullet embeds itself in block' etc.)

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

(b) (i) stress = force/area C1
$= 60/(7.9 \times 10^{-7})$
$= 7.6 \times 10^7$ Pa A1 **[2]**

(ii) Young modulus = stress/strain C1
limiting strain = 0.03/24 ($= 1.25 \times 10^{-3}$) C1
Young modulus = $(7.6 \times 10^7)/(1.25 \times 10^{-3}) = 6.1 \times 10^{10}$ Pa A1 **[3]**

(iii) energy = $½ \times 60 \times 3.0 \times 10^{-4}$ C1
$= 9.0 \times 10^{-3}$ J A1 **[2]**

(c) If hard, ball does not deform (much) B1
and <u>either</u> (all) kinetic energy converted to strain energy B1
If soft, E_k becomes strain energy of ball and window B1
(no mention of <u>strain</u> energy, max 2 marks)
<u>or</u> impulse for hard ball takes place over shorter time (B1)
larger force/greater stress (B1) **[3]**

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5 **(a)** When a wave (front) is incident on an edge
or an obstacle/slit/gap M1
Wave 'bends' into the geometrical
shadow/changes direction/spreads A1 **[2]**

(b) (i) $d = 1/(750 \times 10^3)$ C1
$= 1.33 \times 10^{-6}$ m A1 **[2]**

(ii) $1.33 \times 10^{-6} \times \sin 90° = n \times 590 \times 10^{-9}$ C1
$n = 2$ (must be an integer) A1 **[2]**

(iii) formula assumes no path difference of light before
entering grating <u>or</u>
there is a path difference before the grating B1 **[1]**

(c) e.g. lines further apart in second order
lines fainter in second order
(allow any sensible difference: 1 each, max 2) B2 **[2]**
(if differences stated but without reference to the orders, max 1 mark)

6 **(a) (i)** lines normal to plate and equal spacing (at least 4 lines) B1
direction from (+) to earthed plate B1 **[2]**

(ii) $E = 160/0.08$ M1
$= 2.0 \times 10^3$ V m^{-1} A0 **[1]**

(b) (i) correct directions with line of action of arrows
passing through charges B1 **[1]**

(ii) force $= Eq$ C1
$= 2.0 \times 10^3 \times 1.2 \times 10^{-15}$
$= 2.4 \times 10^{-12}$ N A1 **[2]**

(iii) couple = force × perpendicular separation M1
$= 2.4 \times 10^{-12} \times 2.5 \times 10^{-3} \times \sin 35°$
$= 3.4(4) \times 10^{-15}$ N m A1 **[2]**

(iv) <u>either</u> **rotates** to align with the field
<u>or</u> **oscillates** (about a position) M1
with the positive charge nearer
to the earthed plate/clockwise A1 **[2]**

7 **(a)** potential difference/current B1 **[1]**

(b) (i) **1)** 1.13 W
2) 1.50 V B1 **[1]**

(ii) power = V^2 / R <u>or</u> power = VI and $V = IR$ C1
$R = 1.50^2/1.13$
$= 1.99\ \Omega$ A1 **[2]**

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(iii) either $E = IR + Ir$ or voltage divided between R and r C1
$I = 1.5 / 2.0$ (=0.75 A) p.d. across R = p.d. Across r = 1.5 C1
$3.0 = 1.5 + 0.75r$
$r = 2.0\ \Omega$ so $R = r = 1.99\ \Omega$ A1 **[3]**

(c) larger p.d. across R means smaller p.d. across r M1
smaller power dissipation at larger value of V A1
since power is VI and I is same for R and r A1 **[3]**

8 **(a)** position shown as $A = 227$, $Z = 91$ B1 **[1]**

(b) Pu shown as $A = 243$, $Z = 94$ B1
D shown with $A = A_{Pu}$ and with $Z = (Z_{Pu} + 1)$ B1 **[2]**

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