CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME
MAXIMUM MARK: 60
SYLLABUS/COMPONENT: 9702/04 PHYSICS Paper 4 (Structured Questions (A2 Core))

UNIVERSITY *of* CAMBRIDGE
Local Examinations Syndicate

Categorisation of marks

The marking scheme categorises marks on the *MACB* scheme.

B marks: These are awarded as independent marks, which do not depend on other marks. For a B-mark to be scored, the point to which it refers must be seen specifically in the candidate's answer.

M marks: These are method marks upon which A-marks (accuracy marks) later depend. For an M-mark to be scored, the point to which it refers must be seen in the candidate's answer. If a candidate fails to score a particular M-mark, then none of the dependent A-marks can be scored.

C marks: These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a C-mark and the candidate does not write down the actual equation but does correct working which shows he/she knew the equation, then the C-mark is awarded.

A marks: These are accuracy or answer marks which either depend on an M-mark, or allow a C-mark to be scored.

Conventions within the marking scheme

BRACKETS
Where brackets are shown in the marking scheme, the candidate is not required to give the bracketed information in order to earn the available marks.

UNDERLINING
In the marking scheme, underlining indicates information that is essential for marks to be awarded.

1 (a) work done in bringing/moving unit mass M1
from infinity to the point.. ...... A1 [2]
(use of 1 kg in the definition – max 1/2)

(b) potential at infinity defined as being zero...................... .... B1
forces are always attractive.. B1
so work got out in moving to point................... .... B1 [3]
(max potential is at infinity – allow 1/3)

(c) (i) $\varphi = -GM/R$
change = $6.67 \times 10^{-11} \times 6.0 \times 10^{24} \times (\{6.4 \times 10^{6}\}^{-1} - \{1.94 \times 10^{7}\}^{-1})$ C2
change = 4.19×10^{7} J kg^{-1} (ignore sign) A1

(ii) $½mv^2 = m\Delta\varphi$ C1
$v^2 = 2 \times 4.19 \times 10^7 = 8.38 \times 10^7$
v = 9150 m s^{-1} .... A1 [5]

(d) acceleration is not constant... B1 [1]

2 (a) ✗
✗
✓
✓ (-1 for each error or omission) .... B2 [2]

(b) heat lost by liquid gold = 0.95m x 129 x ΔT................................. C1
heat gained (silver) = 0.05m x 235 x (1340 – 300) + 0.05m x 105 000..C1, C1
122.5$m\Delta T$ = 17 470m
ΔT = 143 K...C1
temperature = 143 + 1340 = 1483 K...A1 [5]

(c) e.g. thermocouple/resistance thermometer .... B1 [1]

3 (a) f_0 is at natural frequency of spring (system) B1
this is at the driver frequency .... B1 [2]
(allow 1 mark for recognition that this is resonance)

(b) line: amplitude less at all frequencies B1
peak flatter B1
peak at f_0 or slightly below f_0... B1 [3]

(c) (aluminium) sheet cuts the magnetic flux/field............................. B1
(so) currents/e.m.f. <u>induced</u> in the (metal) sheet B1
these currents dissipate energy M1
less energy available for the oscillations A1
so amplitude smaller .... A0 [4]
('current opposes motion of sheet' scores one of the last two marks)

4 (a) field causes forces on the electrons M1
and the nucleus in opposite directions A1
(field causes) electrons (to be) stripped off the atom.................... B1 [3]

(b) (i) $E = Q/4\pi\varepsilon_0 r^2$ C1
$20 \times 10^3 \times 10^2 = Q/(4\pi \times 8.85 \times 10^{-12} \times 0.21^2$..................................C1
charge = 9.8×10^{-6} C ....A1 [3]

(ii) $V = Q/4\pi\varepsilon_0 r$
$= (9.8 \times 10^{-6})/(4\pi \times 8.85 \times 10^{-12} \times 0.21)$ C1
$= 4.2 \times 10^5$ V .... A1 [2]

(c) e.g. sphere not smooth, humid air, etc .... B1 [1]

5 (a) centripetal force = mv^2/r B1
magnetic force $F = Bqv$ B1
(hence) $mv^2/r = Bqv$ B1
$r = mv/Bq$ .... A0 [3]

(b) $r_\alpha / r_\beta = (m_\alpha / m_\beta) \times (q_\beta / q_\alpha)$ C1
$= (4 \times 1.66 \times 10^{-27})/(9.11 \times 10^{-31} \times 2)$
$= 3.64 \times 10^3$ .... A2 [3]

(c) (i) $r_\alpha = (4 \times 1.66 \times 10^{-27} \times 1.5 \times 10^6)/(1.2 \times 10^{-3} \times 2 \times 1.6 \times 10^{-19})$
$= 25.9$ m A2

(ii) $r_\beta = 25.9 \times 3.64 \times 10^3 = 7.13 \times 10^{-3}$ m .... A1 [3]

(d) (i) deflected upwards B1
but close to original direction B1

(ii) opposite direction to α-particle and 'through side' .... B1 [3]

6 (a) greater binding energy gives rise to release of energy M1
so must be yttrium .... A1 [2]

(b) probability of decay M1
of a nucleus per unit time .... A1 [2]

(c) (i)1 $A = \lambda N$ C1
$3.7 \times 10^6 \times 365 \times 24 \times 3600 = 0.025N$ C1
$N = 4.67 \times 10^{15}$ .... A1 [3]

(i)2 mass $= 0.09 \times (4.67 \times 10^{15})/(6.02 \times 10^{23})$ C1
$= 6.98 \times 10^{-10}$ kg .... A1 [2]

(ii) $A = A_0 e^{-\lambda t}$
$A/A_0 = e^{-0.025t}$ C1
$= 0.88$ .... A1 [2]