CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 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) (i) radial lines B1
pointing inwards B1

(ii) no difference OR lines closer near surface of smaller sphere ..... B1 [3]

(b) (i) $F_G = GMm/R^2$ C1
$= (6.67 \times 10^{-11} \times 5.98 \times 10^{24})/(6380 \times 10^3)^2$
$= 9.80$ N A1

(ii) $F_C = mR\omega^2$ C1
$\omega = 2\pi/T$ C1
$F_C = (4\pi^2 \times 6380 \times 10^3)/8.64 \times 10^4)^2$
$= 0.0337$ N A1

(iii) $F_G - F_C = 9.77$ N ..... A1 [6]

(c) because acceleration (of free fall) is (resultant) force per unit mass B1
acceleration $= 9.77$ m s^{-2} ..... B1 [2]

2 (a) (i) a, ω and x identified ……(-1 each error or omission) B2

(ii) (-)ve because a and x in opposite directions
OR a directed towards mean position/centre ..... B1 [3]

(b) (i) forces in springs are $k(e + x)$ and $k(e – x)$ C1
resultant $= k(e + x) – k(e – x)$ M1
$= 2kx$ ..... A0 [2]

(ii) $F = ma$ B1
$a = -2kx/m$ A0
(-)ve sign explained ..... B1 [2]

(iii) $\omega^2 = 2k/m$ C1
$(2\pi f)^2 = (2 \times 120)/0.90$ C1
$f = 2.6$ Hz ..... A1 [3]

(c) atom held in position by attractive forces
atom oscillates,
not just two forces *OR* 3D not 1D
force not proportional to x
any two relevant points, 1 each, max 2 ..... B2 [2]

3 (a) pV/T = constant C1
$T = (6.5 \times 10^6 \times 30 \times 300)/(1.1 \times 10^5 \times 540)$ C1
$= 985$ K ..... A1 [3]
(*if uses °C, allow 1/3 marks for clear formula*)

3 (b) (i) $\Delta U = q + w$
symbols identified correctly M1
directions correct ..... A1 [2]

(ii) q is zero B1
w is positive OR $\Delta U = w$ and U increases B1
ΔU is rise in kinetic energy of <u>atoms</u> M1
and mean kinetic energy $\propto T$ ..... A1 [4]
(*allow one of the last two marks if states 'U increases so T rises'*)

4 (a) single diode M1
in series with R *OR* in series with a.c. supply ..... A1 [2]

(b) (i)1 5.4 V (allow ± 0.1 V) A1

(i)2 $V = iR$
$I = 5.4/1.5 \times 10^{3}$ C1
$= 3.6 \times 10^{-3}$ A A1

(i)3 time = 0.027 s ..... A1 [4]

(ii)1 $Q = it$
$= 3.6 \times 10^{-3} \times 0.027$ C1
$= 9.72 \times 10^{-5}$ C A1

(ii)2 $C = \Delta Q/\Delta V$ (allow C – Q/V for this mark) C1
$= (9.72 \times 10^{-5})/1.2$
$= 8.1 \times 10^{-5}$ F ..... A1 [4]

(c) line: reasonable shape with less ripple ..... B1 [1]

5 (a) field producing force of 1.0 N m^{-1} on wire *OR* $B = F/IL\sin\theta$ M1
carrying current of 1.0 A normal to field *OR* symbols explained ... A1 [2]

(b) (i) $\phi = BA$
$= 1.8 \times 10^{-4} \times 0.60 \times 0.85$ C1
$= 9.18 \times 10^{-5}$ Wb ..... A1 [2]

(ii)1 $\Delta\phi = 9.18 \times 10^{-5}$ Wb A1

(ii)2 $e = (N\Delta\phi)/\Delta t$
$= (9.18 \times 10^{-5})/0.20$ C1
$= 4.59 \times 10^{-4}$ V ..... A1 [3]

(iii) there is an e.m.f. and a complete circuit
OR no resultant e.m.f. from other three sides
OR no e.m.f. in AB so yes ..... B1 [1]

6 (a) packet/quantum of energy M1
energy = hf ..... A1 [2]

(b) e.g. threshold frequency outlined
max. k.e. independent of intensity
max. k.e. dependent on frequency (n.b. NOT proportional)
photoelectric current depends on intensity
instantaneous emission …. (*1 each, max 3*) ..... B3 [3]

(c) (i) photons have same energy so E_{max} unchanged
intensity *OR* number of photons per unit time is halved,
so *½n OR n* reduced B1
(allow 1 mark for statement that E_{max} unchanged and *n* reduced)

(ii) photons have higher energy so E_{max} increases B1
but fewer photons per unit time so *n* decreases ..... B1 [4]
(allow 1 mark for statement that E_{max} increases and n reduced)
(allow any argument based on increased efficiency)