CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2002

GCE Advanced Level

MARK SCHEME
MAXIMUM MARK : 60
SYLLABUS/COMPONENT :9702 /4 PHYSICS (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) $g = GM/R^2$ C1
$M = 9.81 \times (6.38 \times 10^6)^2 / 6.67 \times 10^{-11}$ M1
$= 5.99 \times 10^{24}$ kg .... A0 [2]
(allow 2 marks if $g = 9.8$ N kg^{-1} used, 1 mark if $g = 10$ N kg^{-1} used)

(b) (i) T = 24 hours C1
$\omega = 2\pi / (24 \times 3600)$ or $2\pi / T$ C1
$= 7.27 \times 10^{-5}$ rad s^{-1} .... A1 [3]
(ii) $mr\omega^2 = GMm / r^2$ C1
$r^3 = 7.55 \times 10^{22}$ C1
$r = 4.23 \times 10^7$ m .... A1 [3]

2 (a) (i) volume <u>increases</u> on evaporation B1
so work done pushing back the atmosphere B1
(ii) E_k of atoms constant (as no temperature change) B1
E_p changes because separation of atoms changes B1
so internal energy changes because $U = E_k + E_p$ .... B1 [5]

(b) $\Delta U = \Delta W + \Delta Q$ M1
argument leading to ΔQ being positive .... A1 [2]

3 (a) (i) <u>mean</u> kinetic energy M1
of the atoms / molecules / particles A1
(ii) at absolute zero, atoms have no kinetic energy .... B1 [3]

(b) (i) $pV = nRT$ C1
$n = (1.2 \times 10^5 \times 2.0 \times 10^{-2}) / (8.31 \times 310)$ C1
$= 0.93$ mol A1
(ii) total amount = (1.20 + 0.93) C1
$(1.20 + 0.93) = (4.0 \times 10^{-2} \times p) / (8.31 \times 310)$ C1
$p = 1.37 \times 10^5$ Pa .... A1 [6]

4 (a) (i) acceleration proportional to distance (from fixed point) /displacement M1
and directed towards fixed point A1
(ii) graph: straight line through origin M1
in quadrants 2 and 4 .... A1 [4]

(b) graph: sinusoidal curve, all above t-axis B1
correct period M1
correct 'phase' .... A1 [3]

(c) period shorter B1
amplitude larger .... B1 [2]

5 (a) work done in moving unit (positive) charge M1
from infinity to the point and charge is positive .... A1 [2]

(b) (i) $V = Q / 4\pi\varepsilon_0 r$ where ε_0 is permittivity (of free space) B1
(ii) $C = Q / V$ B1
(iii) hence $C = 4\pi\varepsilon_0 r$ .... B1 [3]

(c) (i)1 $C = 4\pi \times 8.85 \times 10^{-11} \times 0.15$
$= 1.67 \times 10^{-5}\ \mu F$ B1
2 energy $= \frac{1}{2}CV^2$ or $\frac{1}{2}QV$ C1
potential $= (2.0 \times 10^{-6}) / (1.67 \times 10^{-11}) = 1.2 \times 10^5$ V C1
energy $= \frac{1}{2} \times 1.67 \times 10^{-11} \times (1.2 \times 10^5)^2$
$= 0.12$ J .... A1 [4]

6 (a) sketch: peaks in opposite directions in correct regions B1
no e.m.f. when current constant B1
correct shape for one of the pulses .... B1 [3]

(b) (i) two correct diodes circled .... B1 [1]
(ii) $V_{max} = \sqrt{2} \times V_{rms}$ C1
$= 8.48$ V .... A1 [2]
(iii) capacitor connected across SQ B1
discharges through load when p.d. / current in load reduces B1
thus maintains p.d. across load (or other relevant comment) .... B1 [3]

7 (a) photoelectric effect .... B1 [1]

(b) (i) reasonable line extrapolated C1
6.8×10^{14} Hz (allow $\pm 0.4 \times 10^{14}$ Hz) A1
(ii) attempt at finding gradient M1
working shown to give 6.6×10^{-34} J s Hz (allow $\pm 0.4 \times 10^{14}$ Hz) .... A1 [4]

(c) line: same gradient B1
to the left of the line drawn by candidate .... B1 [2]

(d) maximum corresponds to electron emitted from surface B1
other electrons require energy to be brought to the surface .... B1 [2]