

**JUNE 2002**

**GCE Advanced Level**

**MARK SCHEME**

**MAXIMUM MARK : 60**

**SYLLABUS/COMPONENT :9702 /4**  
**PHYSICS**  
**(STRUCTURED QUESTIONS (A2 CORE))**



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### 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.

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- 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  $g = 9.8 \text{ N kg}^{-1}$  used, 1 mark if  $g = 10 \text{ N kg}^{-1}$  used)
- (b) (i)  $T = 24$  hours ..... C1  
 $\omega = 2\pi / (24 \times 3600)$  or  $2\pi / T$  ..... C1  
 $= 7.27 \times 10^{-5} \text{ rad s}^{-1}$  ..... A1 [3]
- (ii)  $mr\omega^2 = GMm/r^2$  ..... C1  
 $r^3 = 7.55 \times 10^{22}$  ..... C1  
 $r = 4.23 \times 10^7 \text{ m}$  ..... A1 [3]
- 2 (a) (i) volume increases 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  $\Delta Q$  being positive ..... A1 [2]
- 3 (a) (i) mean 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  
 $= 0.93 \text{ mol}$  ..... 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  
 $p = 1.37 \times 10^5 \text{ Pa}$  ..... A1 [6]

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- 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)  $V = Q / 4\pi\epsilon_0 r$  where  $\epsilon_0$  is permittivity (of free space) ..... B1  
(ii)  $C = Q / V$  ..... B1  
(iii) hence  $C = 4\pi\epsilon_0 r$  ..... B1 [3]
- (c) (i)1  $C = 4\pi \times 8.85 \times 10^{-11} \times 0.15$   
 $= 1.67 \times 10^{-5} \mu\text{F}$  ..... B1  
2 energy =  $\frac{1}{2}CV^2$  or  $\frac{1}{2}QV$  ..... C1  
potential =  $(2.0 \times 10^{-6}) / (1.67 \times 10^{-11}) = 1.2 \times 10^5 \text{ V}$  ..... C1  
energy =  $\frac{1}{2} \times 1.67 \times 10^{-11} \times (1.2 \times 10^5)^2$   
 $= 0.12 \text{ J}$  ..... 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)  $V_{\text{max}} = \sqrt{2} \times V_{\text{rms}}$  ..... C1  
 $= 8.48 \text{ V}$  ..... 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]

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- 7 (a) photoelectric effect ..... B1 [1]
- (b) (i) reasonable line extrapolated ..... C1  
 $6.8 \times 10^{14}$  Hz (allow  $\pm 0.4 \times 10^{14}$  Hz) ..... A1
- (ii) attempt at finding gradient ..... M1  
working shown to give  $6.6 \times 10^{-34}$  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]