

**CAMBRIDGE**  
INTERNATIONAL EXAMINATIONS

**NOVEMBER 2002**

**GCE Advanced Level**

**MARK SCHEME**

**MAXIMUM MARK : 60**

**SYLLABUS/COMPONENT :9702 /4**

**PHYSICS  
(STRUCTURED QUESTIONS (A2 CORE))**



UNIVERSITY of CAMBRIDGE  
Local Examinations Syndicate

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- 1 (a) (i)  $Q = mc\Delta\theta$  ..... C1  
 $2300 = 0.75 \times c \times (100 - 20) / 120$  ... (if uses  $\pm 273$ , then  $-2$ )..... C1  
 $c = 4600 \text{ J kg}^{-1} \text{ K}^{-1}$  ... (allow 1 sf)..... A1
- (ii)  $Q = mL$  ..... C1  
 $2300 = (0.375 / 420) \times L$   
 $L = 2.6 \times 10^6 \text{ J kg}^{-1}$  ... (allow 1 sf)..... A1 [5]
- (b) e.g. heat losses, power not constant etc ..... M1  
(do not allow if related to s.h.c., rather than l.h.c.)  
effect on value for  $L$  ..... A1 [2]
- 2 (a)  $E = hc / \lambda = (6.63 \times 10^{-34} \times 3.0 \times 10^8) / (486 \times 10^{-9})$  ..... C1  
 $= 4.09 \times 10^{-19} \text{ J}$  ... (allow 2 sf)..... A1 [2]
- (b) energy level drawn at  $4.09 \times 10^{-19} \text{ J}$  ..... B1  
transition  $4.09 \times 10^{-19}$  to zero clear ..... B1  
transition  $4.09 \times 10^{-19}$  to  $3.03 \times 10^{-19}$  clear ..... B1 [3]  
(-1 for reversed arrows, -1 for extra level at 1.06)
- 3 (a) (i) constant amplitude ..... B1  
(ii) period = 0.75 s ... (allow  $\pm 0.2$  s)..... C1  
 $\omega = 2\pi/T$  ..... C1  
 $\omega = 8.4 \text{ rad s}^{-1}$  ... (-1 for 1 sf)..... A1
- (iii) either use of gradient or  $v = \omega y_0$  ..... C1  
 $v = 0.168 \text{ m s}^{-1}$  ..... A1 [6]  
(allow  $\pm 0.02$  for construction: gradient drawn at wrong place 0/2)
- (b) (i) 1.3 Hz ..... B1  
(ii) at  $\frac{1}{2}f_0$ , 'pulse' provided to mass on alternate/some oscillations ..... M1  
so 'pulses' build up the amplitude ..... A1 [3]
- 4 (a) (i)  $\frac{1}{2}mv^2 = GMm/R$  ..... B1  
 $v^2 = 2GM/R$  ..... A0  
(ii)  $g = GM/R^2$  ..... M1  
clear algebra giving  $v^2 = 2gR$  ..... A1 [3]
- (b)  $\frac{1}{2}mv^2 = 3/2kT$   
 $v^2 = 3kT/m$  ..... C1  
 $3kT/m = 2gR$  ..... C1  
 $T = (2 \times 6.6 \times 10^{-27} \times 9.81 \times 6.4 \times 10^6) / (1.38 \times 10^{-23} \times 3)$  ..... C1  
 $T = 2.0 \times 10^4 \text{ K}$  ..... A1 [4]

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- 5 (a) two capacitors in series  
or any circuit such that  $V \leq 25$  V across any C ..... B1  
in parallel with second series pair or any correct combination ..... B1 [2]
- (b) two capacitors in series in parallel with a single capacitor  
or other correct combination ..... B2 [2]  
(leads not shown, then -1 overall)
- 6 (a) e.g. E-field, force independent of speed, B-field, force  $\propto$  speed ... B2  
E-field, force along field direction, B-field, force normal etc ... B2 [4]
- (b) (i) out of plane of paper (not 'upwards')..... B1  
(ii)  $mv^2 / r = Bqv$  ..... C1  
 $r = (1.67 \times 10^{-27} \times 4.5 \times 10^6) / (0.12 \times 1.6 \times 10^{-19})$  ..... C1  
 $r = 0.39$  m ..... A1 [4]
- (c) (i) arrow pointing up page ..... B1  
(ii)  $Bqv = Eq$  ..... C1  
 $E = 0.12 \times 4.5 \times 10^6$   
 $= 5.4 \times 10^5$  V m<sup>-1</sup> ..... A1 [3]
- (d) gravitational force  $\ll F_B$  or  $F_E$  ..... B1 [1]
- 7 (a) (i) the wire cuts magnetic field ..... B1  
e.m.f. induced when there is a change/cutting of flux..... B1  
(ii) (Lenz) e.m.f. 'opposes' change causing it ..... B1  
as direction of movement changes, so does e.m.f. .... B1 [4]
- (b)  $x_0 = 1.5$  mV ...(allow  $\pm 0.1$ )..... C1  
 $\omega = 2\pi / T = 2\pi / (3 \times 10^{-3})$  ..... C1  
 $= 2090$  rad s<sup>-1</sup> ..... C1  
 $x = 1.5 \sin 2090t$  ..... A1 [4]

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- 8 (a) probability of decay of a nucleus ..... M1  
per unit time ..... A1 [2]
- (b)  $A = \lambda N$  ...(ignore sign)..... B1 [1]
- (c) (i)  $1 \text{ m}^3$  contains  $1 / 0.024 = 41.7 \text{ mol}$  ..... C1  
 $1 \text{ m}^3$  contains  $41.7 \times N_A = 2.5 \times 10^{25}$  molecules ..... A1  
(ii) number =  $(2.5 \times 10^{25}) / (1.5 \times 10^{21}) = 1.67 \times 10^4$  ..... A1  
(iii)  $\lambda T_{1/2} = 0.693$   
 $\lambda = 0.693 / 56 = 0.0124 \text{ s}^{-1}$  ..... C1  
activity =  $0.0124 \times 1.67 \times 10^4$   
= 210 Bq ..... A1 [5]