

NOVEMBER 2002

GCE Advanced Level

MARK SCHEME

MAXIMUM MARK : 60

SYLLABUS/COMPONENT :9702 /4

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



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- 1 (a) (i) $Q = mc\Delta\theta$ C1
 $2300 = 0.75 \times c \times (100 - 20) / 120$...(if uses ± 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 4.09×10^{-19} to zero clear B1
transition 4.09×10^{-19} to 3.03×10^{-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 ± 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 ± 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⁻¹ 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 ± 0.1) C1
 $\omega = 2\pi / T = 2\pi / (3 \times 10^{-3})$ C1
 $= 2090$ rad s⁻¹ 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 m^3 contains $1 / 0.024 = 41.7 \text{ mol}$ C1
 1 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]