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

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 releated 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 4.09×10^{-19} 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]

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 $<< F_B$ 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]

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 mol C1
1 m^3 contains 41.7 x N_A = 2.5×10^{25} molecules A1

(ii) number = $(2.5 \times 10^{25}) / (1.5 \times 10^{21}) = 1.67 \times 10^4$ A1

(iii) $\lambda T_{½} = 0.693$
$\lambda = 0.693 / 56 = 0.0124\ s^{-1}$ C1
activity = $0.0124 \times 1.67 \times 10^4$
= 210 Bq .... A1 [5]