

November 2003

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME
MAXIMUM MARK: 60
SYLLABUS/COMPONENT: 9702/04 PHYSICS Paper 4 (Structured Questions (A2 Core))



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	A/AS LEVEL EXAMINATIONS - NOVEMBER 2003	9702	04

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)	(i)	radial lines..... B1 pointing inwards..... B1		
		(ii)	no difference OR lines closer near surface of smaller sphere B1	[3]	
	(b)	(i)	$F_G = GMm/R^2$ C1 $= (6.67 \times 10^{-11} \times 5.98 \times 10^{24})/(6380 \times 10^3)^2$ $= 9.80 \text{ N}$ A1		
			(ii)	$F_C = mR\omega^2$ C1 $\omega = 2\pi/T$ C1 $F_C = (4\pi^2 \times 6380 \times 10^3)/8.64 \times 10^4)^2$ $= 0.0337 \text{ N}$ A1	
		(iii)	$F_G - F_C = 9.77 \text{ N}$ A1	[6]	
	(c)	because acceleration (of free fall) is (resultant) force per unit mass B1 acceleration = 9.77 m s^{-2} B1	[2]		
	2	(a)	(i)	a, ω and x identified(-1 each error or omission) B2	
			(ii)	(-)ve because a and x in opposite directions OR a directed towards mean position/centre..... B1	[3]
		(b)	(i)	forces in springs are $k(e + x)$ and $k(e - x)$ C1 resultant = $k(e + x) - k(e - x)$ M1 $= 2kx$ A0	[2]
				(ii)	$F = ma$ B1 $a = -2kx/m$ A0 (-)ve sign explained..... B1
(iii)			$\omega^2 = 2k/m$ C1 $(2\pi f)^2 = (2 \times 120)/0.90$ C1 $f = 2.6 \text{ Hz}$ A1	[3]	
(c)		atom held in position by attractive forces atom oscillates, not just two forces OR 3D not 1D force not proportional to x <i>any two relevant points, 1 each, max 2</i> B2	[2]		
3		(a)	$pV/T = \text{constant}$ C1 $T = (6.5 \times 10^6 \times 30 \times 300)/(1.1 \times 10^5 \times 540)$ C1 $= 985 \text{ K}$ A1	[3]	
			(if uses $^{\circ}\text{C}$, allow 1/3 marks for clear formula)		
3		(b)	(i)	$\Delta U = q + w$ symbols identified correctly M1 directions correct..... A1	[2]
			(ii)	q is zero B1 w is positive OR $\Delta U = w$ and U increases B1 ΔU is rise in kinetic energy of <u>atoms</u> M1 and mean kinetic energy $\propto T$ A1 (allow one of the last two marks if states 'U increases so T rises')	[4]

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4 (a)	single diode.....M1 in series with R OR in series with a.c. supply..... A1	[2]
(b) (i)1	5.4 V (allow ± 0.1 V)..... A1	
(i)2	$V = iR$ $I = 5.4/1.5 \times 10^3$ C1 $= 3.6 \times 10^{-3}$ A A1	
(i)3	time = 0.027 s A1	[4]
(ii)1	$Q = it$ $= 3.6 \times 10^{-3} \times 0.027$ C1 $= 9.72 \times 10^{-5}$ C A1	
(ii)2	$C = \Delta Q/\Delta V$ (allow C – Q/V for this mark) C1 $= (9.72 \times 10^{-5})/1.2$ $= 8.1 \times 10^{-5}$ F A1	[4]
(c)	line: reasonable shape with less ripple..... B1	[1]
5 (a)	field producing force of 1.0 N m^{-1} on wire OR $B = F/IL\sin\theta$M1 carrying current of 1.0 A normal to field OR symbols explained ... A1	[2]
(b) (i)	$\phi = BA$ $= 1.8 \times 10^{-4} \times 0.60 \times 0.85$ C1 $= 9.18 \times 10^{-5}$ Wb A1	[2]
(ii)1	$\Delta\phi = 9.18 \times 10^{-5}$ Wb..... A1	
(ii)2	$e = (N\Delta\phi)/\Delta t$ $= (9.18 \times 10^{-5})/0.20$ C1 $= 4.59 \times 10^{-4}$ V A1	[3]
(iii)	there is an e.m.f. and a complete circuit OR no resultant e.m.f. from other three sides OR no e.m.f. in AB so yes..... B1	[1]
6 (a)	packet/quantum of energy.....M1 energy = hf A1	[2]
(b)	e.g. threshold frequency outlined max. k.e. independent of intensity max. k.e. dependent on frequency (n.b. NOT proportional) photoelectric current depends on intensity instantaneous emission (1 each, max 3)..... B3	[3]
(c) (i)	photons have same energy so E_{max} unchanged intensity OR number of photons per unit time is halved, so $\frac{1}{2}n$ OR n reduced B1 (allow 1 mark for statement that E_{max} unchanged and n reduced)	
(ii)	photons have higher energy so E_{max} increases..... B1 but fewer photons per unit time so n decreases B1 (allow 1 mark for statement that E_{max} increases and n reduced) (allow any argument based on increased efficiency)	[4]