June 2004

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME

MAXIMUM MARK: 60

SYLLABUS/COMPONENT: 9702/02

PHYSICS
Paper 2 (Structured Questions (AS))

UNIVERSITY of CAMBRIDGE
International Examinations

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.

1 (a) scalar: magnitude only — B1
vector: magnitude and direction *(allow scalar with direction)* — B1 **[2]**
(allow 1 mark for scalar has no direction, vector has direction)

(b) diagram has correct shape — M1
with arrows in correct directions — A1
resultant = 13.2 ± 0.2 N *(allow 2 sig. fig)* — A2 **[4]**
(for 12.8 → 13.0 and 13.4 → 13.6, allow 1 mark)
(calculated answer with a correct sketch, allow max 4 marks)
(calculated answer with no sketch – no marks)

Total **[6]**

2 (a) (i) λ = 0.6 m — B1

(ii) frequency (= v/λ) = 330/0.60 — C1
= 550 Hz — A1 **[3]**
(use of $c = 3 \times 10^8$ ms^{-1} scores no marks)

(b) amplitude shown as greater than *a* but less than 2*a* and constant — B1
correct phase — B1 **[2]**
(wave to be at least three half-periods, otherwise -1 overall)

Total **[5]**

3 (a) (i) scatter of points (about the line) — B1

(ii) intercept (on t^2 axis) — B1 **[2]**
(note that answers must relate to the graph)

(b) (i) gradient = $\Delta y/\Delta x$ = (100 – 0)/(10.0 – 0.6) — C1
gradient = 10.6 (cm s^{-2}) *(allow ±0.2)* — A1 **[2]**
(Read points to within $\pm\frac{1}{2}$ square. Allow 1 mark for 11 cm s^{-2}
i.e. 2 sig fig, -1. Answer of 10 scores 0/2 marks)

(ii) $s = ut + \frac{1}{2}at^2$ — B1
so acceleration = 2 x gradient — B1
acceleration = 0.212 m s^{-2} — B1 **[3]**

Total **[7]**

4 (a) (i) (p =) mv — B1

(ii) $E_k = \frac{1}{2}mv^2$ — B1
algebra leading to — M1
$E_k = p^2/2m$ — A0 **[3]**

(b) (i) Δp = 0.035 (4.5 + 3.5) OR a = (4.5 + 3.5)/0.14 — C1
= 0.28 N s = 57.1 m s^{-2}
force = $\Delta p/\Delta t$ (= 0.28/0.14) OR F = ma (= 0.035 x 575.1) (allow e.c.f.) — C1
= 2.0 N — A1
Note: candidate may add mg = 0.34 N to this answer, deduct 1 mark
upwards — B1 **[4]**

(ii) loss = $\frac{1}{2}$ x 0.035 ($4.5^2 - 3.5^2$) — C1
= 0.14 J — A1 **[2]**
(No credit for $0.28^2/(2 \times 0.035) = 1.12$ J)

(c) e.g. plate (and Earth) gain momentum
i.e. discusses a 'system' — B1
equal and opposite to the change for the ball
i.e. discusses force/momentum — M1
so momentum is conserved
i.e. discusses consequence — A1 **[3]**

Total **[12]**

5	**(a)**	**(i)**	distance = $2\pi nr$			B1	
		(ii)	work done = F x 2 πnr *(accept e.c.f.)*			B1	**[2]**
	(b)		total work done = 2 x F x $2\pi nr$			B1	
			but torque $T = 2Fr$			B1	
			hence work done = T x $2\pi n$			A0	**[2]**
	(c)		power = work done/time (= 470 x 2π x 2400)/60)				
			= 1.2 x 10^5 W			A1	**[2]**
					Total		**[6]**
6	**(a)**		When two (or more) waves meet *(not 'superpose' or 'interfere')*			B1	
			resultant <u>displacement</u>			M1	
			is the sum of individual (displacements)			A1	**[3]**
	(b)	**(i)**	any correct line through points of intersection of crests			B1	
		(ii)	any correct line through intersections of a crest and a trough			B1	**[2]**
	(c)	**(i)**	$\lambda = ax/D$ OR $\lambda = a\sin\theta$ and $\theta = x/D$			C1	
			650 x 10^{-9} = (a x 0.70 x 10^{-3})/1.2			C1	
			a = 1.1 x 10^{-3} m			A1	**[3]**
		(ii) 1	no change			B1	
		2	brighter			B1	
		3	no change *(accept stay/remain dark)*			B1	**[3]**
					Total		**[11]**
7	**(a)**	**(i)**	$P = VI$			C1	
			current = 60/240 = 0.25 A			A1	
		(ii)	R (= V/I) = 240/0.25			M1	
			= 960 Ω			A0	**[3]**
	(b)		$R = \rho L/A$ *(wrong formula, 0/3)*			C1	
			960 = (7.9 x 10^{-7} x L)/(π x {6.0 x 10^{-6}}^{2})			C1	
			L = 0.137 m			A1	**[3]**
			(use of $A = 2\pi r$, then allow 1/3 marks only for resistivity formula)				
	(c)		e.g. the filament must be coiled/it is long for a lamp			B1	**[1]**
			(allow any sensible comment based on candidate's answer for L)				
					Total		**[7]**
8	**(a)**		$V/E = R/R_{tot}$	or	0.5 = I x 3900	C1	
			1.0/1.5 = R/(R + 3900)	or	1.0 = 0.5R/3900	M1	
			R = 7800Ω.	or	R = 7800Ω	A0	**[2]**
	(b)		V = 1.5 x (7800/{7800 + 1250})	or	I = 1.5/(7800 + 1250)	C1	
			= 1.29 V..	or	$V = IR$ = 1.29 V	A1	**[2]**
	(c)		Combined resistance of R and voltmeter is 3900 Ω			C1	
			reading at 0 °C is 0.75 V			A1	**[2]**
					Total		**[6]**