CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2002

GCE Advanced Level

MARK SCHEME

MAXIMUM MARK : 40

SYLLABUS/COMPONENT :9702 /6

PHYSICS
(OPTIONS (A2))

UNIVERSITY *of* CAMBRIDGE
Local Examinations Syndicate

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 bracket information in order to earn the available marks.

UNDERLINING
In the marking scheme, underlining indicates information that is essential for marks to be awarded.

Option A

1 (a)		1.50×10^{11} m (accept 1.49×10^{11} m)	B1	[1]
(b)	(i)	distance at which 1 AU	M1	
		subtends an angle of 1 second of arc	A1	
	(ii)	arc = $r\theta$	C1	
		1 arc second = $2\pi / (360 \times 3600)$ = (4.85×10^{-6}) rad	C1	
		1 pc = $(1.5 \times 10^{11}) / (4.85 \times 10^{-6})$ = 3.09×10^{16} m (accept 3.1×10^{16} m)	A1	[5]
2 (a)		sketch: straight line through origin	B1	[1]
(b)		galaxies are moving away from each other	B1	
		(so) at one time, must have been close together OR max. speed close to *c*, so finite time	B1	[2]
(c)		on sufficiently large scale, Universe is homogeneous OR mentions 'Cosmological Principle'	B1	
		so, no matter where positioned, galaxies are moving away	B1	[2]
(d)	(i)	$H_0 = v/d$	C1	
		this is the gradient of the graph	A1	
	(ii)	(d/v is the time for galaxies to separate i.e.) 1/gradient (allow $1/H_0$ if H_0 stated to be the gradient)	B1	[3]
3 (a)		allow 10^2 s – 10^4 s	B1	[1]
(b)		allow 10^{12} s – 10^{14} s	B1	[1]
(c)		later than (b) but about 10^{13} s – 10^{14} s	B1	[1]
4		e.m. radiation received is very faint	C1	
		radiation is absorbed by atmosphere	B1	
		so use detection systems in Earth orbit	B1	[3]

Option F

5 (a) (i) reasonable position B1
(ii) reasonable construction with M marked .... B1 [2]

(b) restoring couple increases (1)
ship is more stable (1)
so ship less likely to move with the waves <u>or</u>
more likely to act as rigid wall against waves (1)
any two, 1 each max 2 .... B2 [2]

6 (a) (i) A_1v_1 .... B1
(ii) ρA_1v_1 .... B1 [2]

(b) (i) $E_k = \frac{1}{2}mv^2$ C1
$\frac{1}{2}\rho A_2v_2^3 - \frac{1}{2}\rho A_1v_1^3$ A1
(ii) work done $= p\Delta V$ C1
$p_1A_1v_1 - p_2A_2v_2$ .... A1 [4]
(allow answer to (i) without comment for 2/2)

(c) (i) $p_1A_1v_1 - p_2A_2v_2 = \frac{1}{2}\rho A_2v_2^3 - \frac{1}{2}\rho A_1v_1^3$ B1
now $A_1v_1 = A_2v_2$ B1
$p_1 - p_2 = \frac{1}{2}\rho v_2^2 - \frac{1}{2}\rho v_1^2$ A0
(ii) assumption: horizontal flow/streamline/non-viscous .... B1 [3]

7 (a) graph: curve from origin M1
approaches/reaches constant speed .... A1 [2]

(b) weight, upthrust and drag act on sphere B1
accelerating force = (apparent) weight - drag
OR = weight – upthrust – drag B1
as speed increases, drag increases B1
so acceleration decreases M1
reaches a constant/terminal speed .... A1 [5]

Option M

8 (a)	pulse of ultrasound	B1	
	reflected (at boundaries)	B1	
	(on return, detected and) processed	B1	
	time delay gives depth	B1	
	strength of echo indicates nature of boundary	B1	[5]
(b) (i) 1.	(high μ means) low penetration (do not allow 'absorbed')	B1	
	also much reflection (at muscle/bone interface)	B1	
2.	ultrasound absorbed in bone	B1	
	causes a heating effect	B1	[4]
(ii)	$(I/I_0)_{muscle} = e^{-23x}$		
	$(I/I_0)_{bone} = e^{-130x}$	C1	
	substitution of value for x <u>or</u> use of indices	C1	
	ratio = 2.9	A1	[3]
9 (a)	short sight / myopia	B1	[1]
(b)	power = - 1/0.75 + 1/∞	C1	
	= - 1.33 D	A1	[2]
(c)	there is greater magnification	B1	
	because able to focus when closer to eye	B1	[2]
10 (a)	$I.L. = 10 \lg(I/I_0)$ with I_0 explained	B1	[1]
(b)	loss of sensitivity at about 3 kHz	B1	
	loss of hearing at higher frequencies (- cut-off should be about 15 kHz) ...	B1	[2]

Option P

11 (a)	e.g. energy from tidal flow / stores excess electrical energy	B2	
	dependent on time of tides / available to meet peak demands	B2	[4]
(b) (i)	$77\ m^3\ s^{-1} = 77 \times 10^3\ kg\ s^{-1}$	C1	
	energy = mgh	C1	
	power = $77 \times 10^3 \times 9.8 \times 180$		
	= 140 MW	A1	

11 (b) (ii)	Answer in (i) must be greater than 100 MW	B1	
	because water falling has k.e. (or other valid point)	B1	[5]
	(calculation of efficiency as 74% - allow 1/2)		
12 (a)	mass of air <u>per unit time</u> = $\pi r^2 \rho v$	B1	
	kinetic energy = $\frac{1}{2}mv^2$	B1	
	$E = \frac{1}{2}\pi r^2 \rho v \cdot v^2$	M1	
	$= \frac{1}{2}\pi r^2 \rho v^3$	A0	[3]
(b)	$E = 0.55 \times \frac{1}{2} \times \pi \times 12^2 \times 1.2 \times 4.5^3$	C1	
	= 13.6 kW	A1	[2]
(c)	high speeds cause large stresses (in blades etc)	B1	
	blades are 'feathered'	B1	[2]
13 (a)	not true - visual pollution	B1	
	- pollution during building	B1	[2]
	(allow any two valid points – give credit for justifying 'no pollution' claim)		
(b)	Many generators required over a large area	B1	
	other valid point e.g. weather dependence etc	B1	[2]

Option T

14 (a)	amplitude modulated	B1	[1]
(b) (i)	10 waves in 200 μs	C1	
	f = 50 kHz	A1	
(ii)	frequency = 5 kHz	A1	[3]
(c)	graph: three vertical lines	B1	
	carrier longer than equal sidebands	B1	
	frequencies shown correctly	B1	[3]

15 (a) number of dB = $10 \lg(P_1/P_2)$ C1
$25 = 10 \lg (P / (7.3 \times 10^{-5})$ M1
$P = 0.023$ W .... A0 [2]

(b) change in signal power = $10 \lg(5.8/0.023)$ C1
$= 24$ dB C1
length = 24 / 4.8 = 5.0 km .... A1 [3]

(c) e.g. less interference
greater uninterrupted length
no cross-talk etc (any valid points, 1 each) .... B2 [2]

16 (a) e.g. weather forecasting
prospecting etc (any two valid points, 1 each) .... B2 [2]

(b) e.g. weather monitoring
telephone communication (any two valid points, 1 each) .... B2 [2]

(c) (i) allow 1 cm → 20 cm B1
(ii) e.g. prevent swamping of incoming signal .... B1 [2]