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 or
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 or use of indices C1
ratio = 2.9 ..... A1 [3]

9 (a) short sight / myopia ..... B1 [1]

(b) power = $-1/0.75 + 1/\infty$ 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 per unit time = $\pi r^2 \rho v$ B1
kinetic energy = $\frac{1}{2}mv^2$ B1
$E = \frac{1}{2}\pi r^2 \rho v \,.\, v^2$ 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 x 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]