

**JUNE 2002**

**GCE Advanced Level**

**MARK SCHEME**

**MAXIMUM MARK : 40**

**SYLLABUS/COMPONENT :9702 /6**

**PHYSICS  
(OPTIONS (A2))**

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### 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.

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**Option A**

- 1 (a)  $1.50 \times 10^{11}$  m (accept  $1.49 \times 10^{11}$  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 =  $2\pi / (360 \times 3600) = (4.85 \times 10^{-6})$  rad ..... C1  
1 pc =  $(1.5 \times 10^{11}) / (4.85 \times 10^{-6}) = 3.09 \times 10^{16}$  m ..... A1 [5]  
(accept  $3.1 \times 10^{16}$  m)
- 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.)  $1/\text{gradient}$  ..... B1 [3]  
(allow  $1/H_0$  if  $H_0$  stated to be the gradient)
- 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)  $\rho A_1v_1$  ..... 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]

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### 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  $\mu$  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)  $(I/I_0)_{\text{muscle}} = e^{-23x}$   
 $(I/I_0)_{\text{bone}} = e^{-130x}$  ..... 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)  $77 \text{ m}^3 \text{ s}^{-1} = 77 \times 10^3 \text{ kg s}^{-1}$  ..... C1  
energy =  $mgh$  ..... C1  
power =  $77 \times 10^3 \times 9.8 \times 180$   
= 140 MW ..... A1

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- 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  
 $E = \frac{1}{2}\pi r^2 \rho v \cdot v^2$  ..... 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  $\mu$ s ..... 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  
 $P = 0.023 \text{ W}$  ..... A0 [2]
- (b) change in signal power =  $10 \lg(5.8/0.023)$  ..... C1  
 $= 24 \text{ dB}$  ..... C1  
length =  $24 / 4.8 = 5.0 \text{ km}$  ..... 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  $\rightarrow$  20 cm ..... B1  
(ii) e.g. prevent swamping of incoming signal ..... B1 [2]