

# UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

## MARK SCHEME for the November 2005 question paper

### 9702 PHYSICS

9702/06

Options maximum raw mark 40

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

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### Option A - Astrophysics and Cosmology

- 1 (a) (i) (mean) distance between Earth and Sun B1 [1]  
(ii) distance at which 1 AU subtends an angle M1  
of one arc-second A1 [2]
- (b)  $\text{arc} = r\theta$  C1  
 $1.5 \times 10^{11} = r \times 2\pi / (360 \times 60 \times 60)$  M1  
 $1.0 \text{ pc} = 3.09 \times 10^{16} \text{ m}$  A1 [3]
- 2 (a) e.g. 3 K microwave background radiation  
redshift of light from galaxies  
*any two sensible suggestions, 1 each, max 2* B2 [2]
- (b) If Universe is static and infinite B1  
then every line of sight would end on a star M1  
so night would be as bright as day A1 [3]
- (c) depends on (mean) density of matter in the Universe B1  
greater than a certain value, Universe will expand and then contract B1  
below this certain value, Universe will expand indefinitely B1 [3]
- 3 (a) e.g. absorption of IR by water vapour in atmosphere  
much stray IR at Earth's surface  
*any two sensible suggestions, 1 each, max 2* B2 [2]
- (b) e.g. distant galaxies B1  
moving so fast that they are red-shifted into IR B1  
e.g. cool objects (brown dwarfs) B1  
give off IR but not visible light B1 [4]  
*allow any two sensible suggestions (2) + reasoning (1 + 1)*

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### Option F - The Physics of Fluids

- 4 (a) e.g. incompressible fluid / constant density  
horizontal flow  
non-viscous  
streamline  
*any three, 1 each, max 3* B3 [3]
- (b) force =  $A\Delta p$  C1  
=  $25 \times \frac{1}{2} \times 1.2 \times (85^2 - 75^2)$  C1  
=  $2.4 \times 10^4$  N A1 [3]
- 5 (a) (i) centre of mass of displaced fluid B1 [1]  
(ii) B shown at centre of submerged section B1 [1]  
(iii) upthrust acts upwards through B B1  
weight acts downwards through C B1  
these two forces provide a restoring couple B1 [3]
- (b) (i) becomes less B1 [1]  
(ii) decrease B1 [1]  
(iii) increases B1 [1]
- (c) C and B coincide M1  
no longer providing a restoring couple A1 [2]
- 6 (a) non-steady / haphazard flow of fluid B1 [1]
- (b) turbulence represents (continuous) transfer of kinetic energy B1  
this transfer of energy per unit time represents power B1  
power =  $F_D \times$  speed so more power means larger  $F_D$  B1 [3]

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### Option M - Medical Physics

- 7 (a) electrons accelerated / high speed electrons B1  
bombard metal target B1  
electrons decelerated greatly → e.m. radiation B1  
wide range of decelerations gives continuous spectrum B1  
electrons in target atoms excited B1  
de-excitation of these electrons gives line spectrum B1 [6]
- (b) (i) sharpness: ease with which edges of structures can be seen B1 [1]  
(ii) contrast: difference in blackening between structures B1 [1]
- 8 (a) short sight (myopia) B1 [1]
- (b) (i) concave lens drawn B1 [1]  
(ii) rays diverge after passing through the concave lens B1  
rays converge on the retina B1 [2]
- 9 (a) (i) *intensity*: energy per unit area per unit time (normal to area) B1  
*loudness*: subjective response (of a person) to (a given) intensity B1  
(ii) ability to distinguish between two different intensities of sound B1 [3]
- (b) intensity level =  $10 \lg(I / I_0)$   
 $89 = 10 \lg I / (1.0 \times 10^{-12})$  C1  
 $I_{89} = 7.94 \times 10^{-4} \text{ W m}^{-2}$  C1  
 $92 = 10 \lg I / (1.0 \times 10^{-12})$   
 $I_{92} = 1.58 \times 10^{-3} \text{ W m}^{-2}$  C1  
ratio =  $I_{89} / (I_{92} - I_{89})$  C1  
= 1.0 A1 [5]

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### Option P - Environmental Physics

- 10 (a)** diagram: closed box with glass top  
metal base and water tubing  
blackened interior B1 [3]  
B1  
B1
- (b)** largest area normal to sunlight B1 [1]
- (c)** power = flow rate  $\times c \times \Delta\theta$  C1  
 $800 \times 0.35 \times 1.4 = \text{flow rate} \times 4200 \times 15$  C1  
flow rate =  $6.2 \times 10^{-3} \text{ kg s}^{-1}$  A1 [3]
- 11 (a) (i)** change in pressure and volume (and temperature) M1  
without any (thermal) energy entering or leaving the system A1 [2]
- (ii)** the change takes place rapidly B1  
no time for energy to flow in/out of the gas B1 [2]
- (b) (i)** correct direction shown (clockwise) B1 [1]  
**(ii)** correct section marked (vertical section on left of diagram) B1 [1]
- 12 (a)** the lead compounds are released as air pollution B1  
any further comment e.g. cause mental disorders, enter food chain via plants B1 [2]
- (b)** e.g. noise, visual B2 [2]  
*any two sensible suggestions, 1 each, max 2*
- (c) (i)** available without using (fossil) fuels B1 [1]  
**(ii)** e.g. do not produce air pollution, no mining/transportation B2 [2]  
*any two sensible suggestions, 1 each, max 2*

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### Option T - Telecommunications

- 13 (a)** signal is in the form of a series of pulses of light/IR  
pulses pass along a glass fibre  
as a result of total internal reflection
- B1  
B1  
B1 [3]
- (b)** technological: e.g. greater bandwidth, less noise, less power loss per unit length  
*any two sensible suggestions, 1 each, max 2*  
social: e.g. increased security, cheaper, less bulky  
*any two sensible suggestions, 1 each, max 2*
- B2  
B2 [4]
- 14 (a) (i)** thermal energy (in the cable) / resistance
- (ii)** loss =  $10 \lg(0.55 / 0.60)$   
= (-) 0.38 dB  
loss per unit length =  $0.38 / 75 \times 10^{-3}$   
= 5.0 dB km<sup>-1</sup>
- B1 [1]  
C1  
C1  
C1  
A1 [4]
- (b) (i)** unwanted (random) signal power
- (ii)** e.g. molecular/lattice vibrations, pick-up of e.m. signals  
*any two sensible suggestions, 1 each, max 2*
- B1 [1]  
B2 [2]
- 15** digital more reliable than analogue  
fewer people employed in telephone industry  
greater multiplexing means reduced cost per call  
reduced costs means available to more people  
huge expansion international calls  
huge expansion of non-voice communications  
development/expansion of internet  
introduction of multichannel cable TV companies  
*any five sensible statements, 1 each, max 5*
- B5 [5]