

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

NOVEMBER 2002

GCE Advanced Subsidiary Level

MARK SCHEME

MAXIMUM MARK : 40

SYLLABUS/COMPONENT :9702 /6

**PHYSICS
(OPTIONS (A2))**



UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

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Option A

- 1 (a) allow 4 – 15 minutes B1 [1]
 (b) allow 2 – 8 years B1 [1]
 (c) allow 50 k – 150 k years B1 [1]

(If all else fails allow 1 mark for units of minutes, years and k years)

- 2 (a) relative motion between source and observer M1
 wavelength appears longer OR colour shifts towards red A1
 (due to) receding source A1 [3]
 (b) all wavelengths are shifted B1
 so UV becomes visible or visible becomes IR B1 [2]
 alternative: line gives a reference (1)
 so that shift can be measured (1)
 (c) e.g. light pollution
 absorption
 irregular refraction etc any three, 1 each B3 [3]

- 3 (a) $H_0 = 1 / (4.1 \times 10^{17}) = 2.4 \times 10^{-18} \text{ s}^{-1}$ C1
 $\rho_0 = \{3 \times (2.4 \times 10^{-18})^2\} / \{8 \times \pi \times 6.67 \times 10^{-11}\}$ C1
 $= 1.06 \times 10^{-26} \text{ kg m}^{-3}$ C1
 idea of divide density by 1.66×10^{-27} (1 u) C1
 number density = 6.4 A1 [5]
 (b) (i) mention of dark matter B1
 limit of observable Universe B1
 (allow alternatives to max 2)
 (ii) expansion will come to a halt B1
 then collapse B1 [4]

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Option F

- 4 (a) force (on body) acting upwards B1 [1]
- (b) pressure below object is different from pressure above B1
 $(F = pA, \text{ so } \text{force up} > \text{force down})$ B1 [2]
 (accept gravitation as origin of pressure for 1 mark
 acts through CG of displaced fluid for 1 mark)
- (c) upthrust depends on $\Delta p = \rho g \Delta h$
 OR upthrust = weight of fluid displaced B1
 incompressible fluid OR ρ constant B1
 rigid object (so volume not change) B1 [3]
 (first mark may be awarded for any detail anywhere)
- 5 (a) (i) path taken by (a particle of) the fluid B1
 (ii) tube of fluid bounded by streamlines B1
 (iii) streamlines would be crossed by the fluid
or streamlines would not be in direction of flow of fluid B1 [3]
- (b) (i) sketch: smooth lines M1
 approx. symmetry with closer lines at sides A1
 (ii) sketch: eddies behind the object B1
 (iii) e.g. increased (fluid) speed
 OR decreased density
 OR increased viscosity B1 [4]
- 6 (a) (i) friction between layers of fluid B1
 fluid in contact with sides is stationary B1
 (ii) rate of change of velocity with distance B1
 normal to direction of flow of fluid B1 [4]
- (b) speed = $(3 \times 10^{-3}) / (7 \times 24 \times 3600) = 4.96 \times 10^{-9} \text{ m s}^{-1}$ C1
 $1.5 = \eta \times 9.0 \times 10^{-4} \times (4.96 \times 10^{-9}) / (2.2 \times 10^{-6})$ C1
 $\eta = 7.4 \times 10^5 \text{ Pa s}$ A1 [3]

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Option M

- 7 (a) sharpness: clear distinction between boundaries B1
 e.g. parallel X-ray beam / point source B1
 contrast: (large) differences in blackening of different regions ... B1
 (allow changes in colour)
 e.g. differences in attenuation coefficient B1 [4]
- (b) (i) max. energy of photon is 80 keV B1
 below 80 keV, continuous spectrum with sharp peaks B1 [2]
- (ii) $I = I_0 e^{-\mu x}$
 $\frac{1}{2} = e^{-\mu}$ C1
 $\mu = 0.693 \text{ mm}^{-1}$ A1 [2]
- (iii) X-rays are more penetrating B1
 so μ is smaller B1 [2]
- 8 (a) ability of eye to form focused images M1
 of objects at different distances from eye A1 [2]
- (b) star: power = $1/\infty + 1/L$ (L explained) M1
 book: power = $1/0.25 + 1/L$ (0.25 explained) M1
 change in power = $1/0.25 = 4.0 \text{ D}$ A1 [3]
- 9 changes in loudness perceived as $\Delta I / I$ B1
 loudness is log. response to intensity
 OR loudness/sensitivity not linearly dependent on intensity B1
 and $I.L.$ measured as $10 \lg(I/I_0)$ B1
 but perceived loudness depends on frequency B1
 and on the individual B1 [5]

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Option P

- 10 (a) cell: conversion (of solar energy) to electrical energy B1
panel: conversion (of solar energy) to thermal energy B1 [2]
- (b) (i) e.g. calculator, remote road signs B1
(ii) d.c. not a.c. so problems re. distribution B1
vast area of land would need to be covered OR
any other relevant qualitative statement (e.g. time of day!) B1
for 1 kW need about 10 m² OR
for 240 V need several hundred cells in series
OR any other appropriate quantitative statement B1 [4]
- 11 (a) (i) correct direction round cycle ...(allow 3 arrows) B1
(ii) correct direction for both energies B1 [2]
- (b) input with two output arrows M1
approximately correct width for each arrow at point of division .. A1
labels e.g. input, (useful) output, losses and energy values or % . A1 [3]
- (c) (i) efficiency = (useful) output / input C1
= 80 / 210
= 38% A1
(ii) $E_{\max} = (1 - T_L/T_H)$ B1
 T_L cannot be 0 K B1
 T_H has a practical upper limit B1 [5]
- 12 Electric cars produce less pollution at location B1
electrical energy has to be generated B1
(resulting in) pollution at power station B1
any other suitable comment e.g. pollution in cities B1 [4]

Option T

- 13 (a)** series of pulses B1
between discrete levels B1 [2]
- (b)** number of samples per second = $44100 \times 2 = 88200$ C1
number of bits in 1 hour = $88200 \times 16 \times 3600 = 5.1 \times 10^9$ A1 [2]
- (c)** adv: e.g. perfect regeneration possible,
regeneration eliminates noise B1
disadv: extra circuitry (ADC, DAC etc) B1 [2]
- 14 (a) (i)** area represents energy B1
and some loss of light energy in the fibre B1
(ii) difference in number of reflections along the fibre B1
mean different path lengths B1 [4]
- (b)** speed = $1400 / (7.0 \times 10^{-6})$ C1
= $2.0 \times 10^8 \text{ m s}^{-1}$ A1
7 μs because this represents minimum number of reflections B1
so is nearest to path length of 1400 m B1 [4]
- 15 (a) (i)** allow 10 m - 100 m B1
(ii) allow < 10 m B1 [2]
- (b)** sky waves rely on ionospheric reflection B1
ionosphere changes in height, density etc B1
space waves used for satellite communication B1
not affected by ionosphere B1 [4]
(allow feasible alternatives e.g. effect of hills to max 4)