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

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 <u>or</u> 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)** $H_0 = 1 / (4.1 \times 10^{17}) = 2.4 \times 10^{-18}\ s^{-1}$ C1
$\rho_0 = \{3 \times (2.4 \times 10^{-18})^2\} / \{8 \times \pi \times 6.67 \times 10^{-11}\}$ C1
$= 1.06 \times 10^{-26}\ kg\ m^{-3}$ 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]

Option F

4	(a)	force (on body) acting upwards	B1	[1]
	(b)	pressure below object is different from pressure above	B1	
		($F = pA$, so) force up > 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 = $(3 \times 10^{-3}) / (7 \times 24 \times 3600) = 4.96 \times 10^{-9}$ 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	
		$\eta = 7.4 \times 10^{5}$ Pa s	A1	[3]

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
$\mu = 0.693\ mm^{-1}$ ..... 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 = $1/0.25 = 4.0$ 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]

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 m^2 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 <u>at location</u>	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		
		$= 2.0 \times 10^8$ 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)			