OCR

RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

PHYSICS (B) (ADVANCING PHYSICS) 2860

Physics in Action

Monday **14 JUNE 2004** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Data, Formulae and Relationships Booklet
Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Show clearly the working in all calculations and give answers to only a justifiable number of significant figures.

INFORMATION FOR CANDIDATES

- You are advised to spend about 20 minutes on Section A, 40 minutes on Section B and 30 minutes on Section C.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- There are four marks for the quality of written communication in Section C.
- The values of standard physical constants are given in the Data, Formulae and Relationships Booklet. Any additional data required are given in the appropriate question.

FOR EXAMINER'S USE		
Section	Max.	Mark
A	20	
B	40	
C	30	
TOTAL	90	

This question paper consists of 22 printed pages and 2 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

Section A

1 A particular material breaks after plastic deformation. It requires a large energy to create new surface area, but does **not** fracture by crack propagation.

Here is a list of four different mechanical properties.

stiff strong tough hard

Write down the **one** word from the list that best describes this material.

..... [1]

2 The information in the frames of old black and white movie films deteriorates with time. It can be preserved by storing the images as arrays of pixels in a digital format. Unfortunately, defects such as scratches and dirt spots also become digitised.

The pixel values from three small regions **A**, **B** and **C** of a digitised film are shown in Fig. 2.1.

The numbers relate to a greyscale from 0 = white to 255 = black

100	100	120	120	140
100	120	250	250	140
120	120	250	250	140
120	120	140	140	180
120	140	140	180	180

A

180	180	180	100	10
180	180	100	10	10
180	100	10	10	100
100	10	10	100	180
10	10	100	180	180

B

100	120	130	140	150
130	130	140	150	150
140	140	150	150	160
150	150	160	170	170
160	160	170	170	180

C

Fig. 2.1

(a) Identify which region, **A**, **B** or **C**, has been affected by

(i) a white scratch ..... **(ii)** a black dust spot ..... [1]

(b) Explain how you identified the white scratch.

[1]

(c) Suggest a digital image process that could remove or reduce the effect on the pixel values of the dust spot.

[1]

3 A spotlight beam falls on a water surface at an angle of incidence $i = 80°$ as shown in Fig. 3.1.

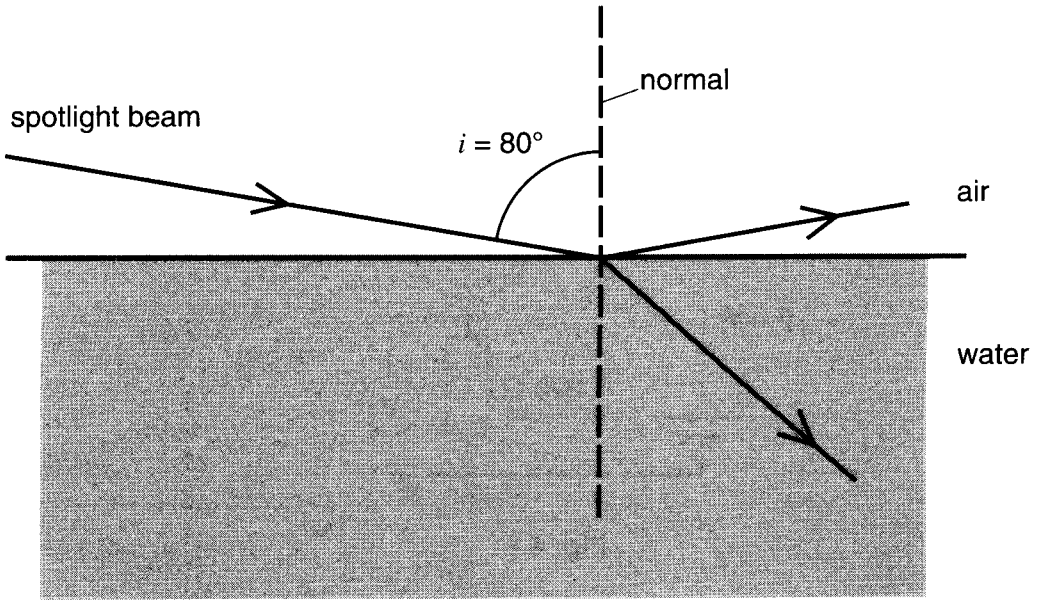

Fig. 3.1

(a) **Label** the angle of refraction r on Fig. 3.1 above. [1]

(b) Calculate the angle of refraction r in the water, quoting your final answer to an appropriate number of significant figures.

refractive index for water $n = 1.3$

[3]

4 Fig. 4.1 shows a light sensing circuit using an LDR, a fixed resistor of resistance 220 Ω and a 6.0 V battery.

The battery in the potential divider circuit is of negligible internal resistance.

The p.d. across the resistor is measured by a digital voltmeter.

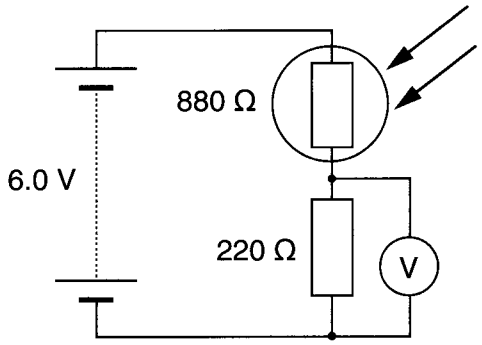

Fig. 4.1

In bright daylight, the resistance of the LDR is 880 Ω.

(a) Calculate the ratio = $\frac{\text{p.d across resistor}}{\text{p.d. across LDR}}$.

ratio = ... [1]

(b) Calculate the voltmeter reading in bright daylight.

p.d. = ... V [2]

5 Here are two relationships for electrical components.

$$P = I\,V \qquad\qquad V = I\,R$$

(a) **Show how** to combine these two relationships to produce an equation for the electrical power P in terms of the current I and resistance R only.

[1]

(b) Complete the following statement.

When the current is doubled in a constant resistance, the power dissipated is increased by a factor of ..... . [1]

[Turn over

6 A microwave transmitter emits vertically polarised electromagnetic waves to a receiver as shown in Fig. 6.1. Three mutually perpendicular directions **x, y** and **z** are shown.

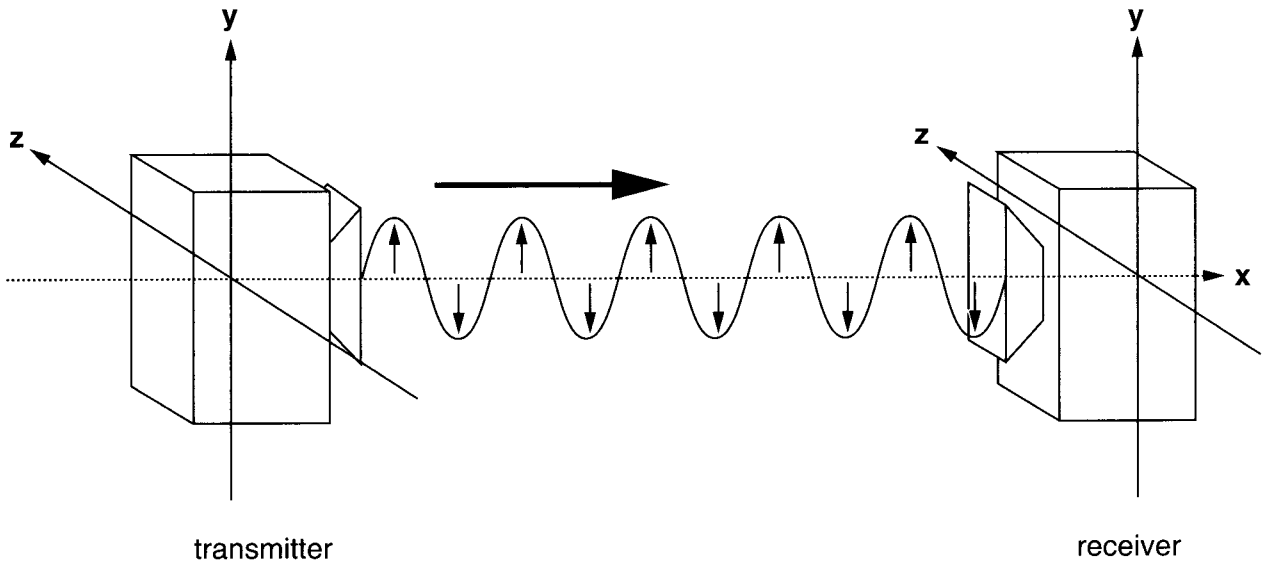

Fig. 6.1

The receiver emits an audible tone when vertically polarised microwaves enter it. The loudness of the sound depends upon the intensity of the microwaves.

Describe a simple experiment you could perform with this equipment to give evidence that the waves are vertically polarised. State the observations you would make.

You may wish to make reference to the directions **x, y** and **z** as shown in Fig. 6.1.

[3]

7 Fig. 7.1 shows two waveforms displayed on an oscilloscope screen.
One is the original analogue signal from a recording of a dolphin whistling.
The other is the result of digitising it to the nearest of 8 binary coded levels.

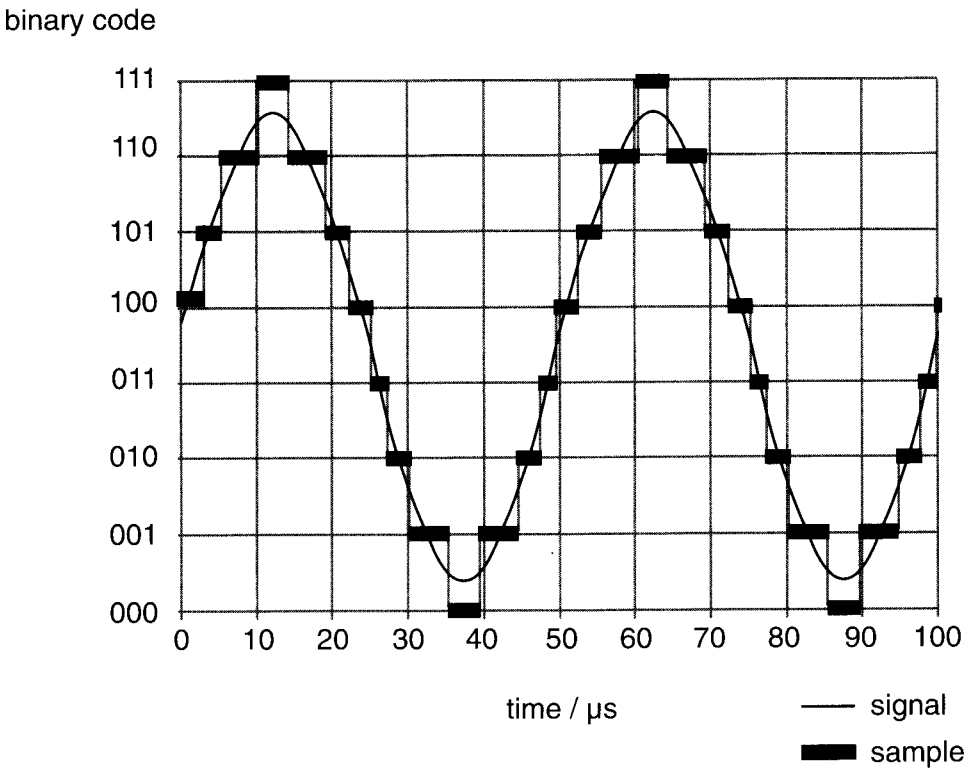

Fig. 7.1

(a) (i) Read from the graph the time period T in microseconds for one complete cycle of the dolphin whistle.

T = ... μs [1]

(ii) Calculate the frequency f corresponding to this time period T.

f = ... Hz [1]

(b) (i) State the number of bits per sample needed to code for the 8 binary levels.

number of bits = ... [1]

(ii) The waveform is sampled every 1.0 μs.

Calculate the rate at which information is digitised in this sampled waveform.

information rate = ... bits s^{-1} [1]

[Section A Total: 20]

[Turn over

Section B

8 This question is about an external rear view mirror on a motor car.
Fig. 8.1 shows the path of one of the light rays that determine the driver's field of view, entering the driver's eye, as seen from above.

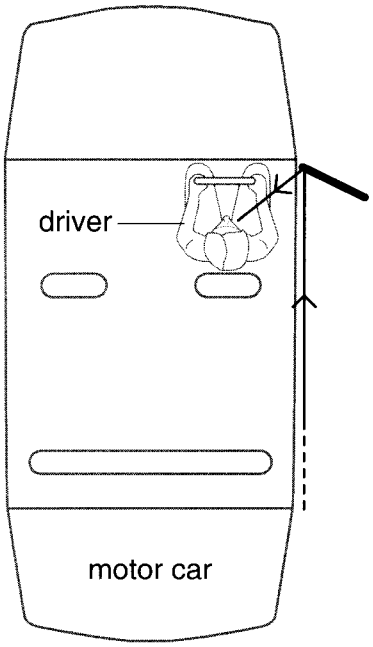

Fig. 8.1

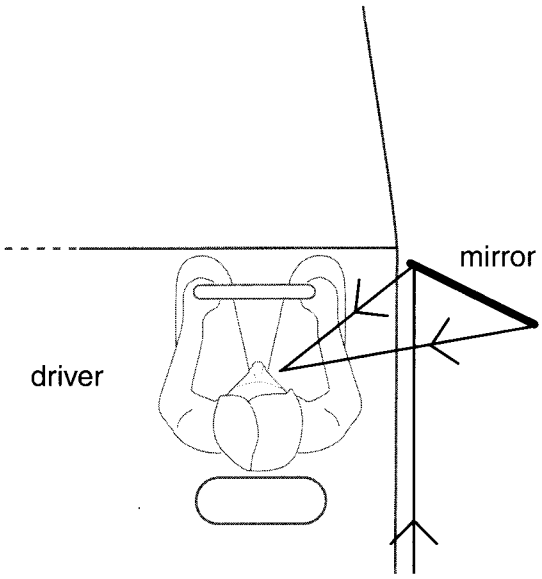

Fig. 8.2 (enlarged view)

(a) On Fig. 8.2, complete the path of the light ray incident near the outer edge of the plane mirror. [1]

(b) Another design of rear view mirror has an extra section at its outer edge at a different angle as shown in Fig. 8.3.

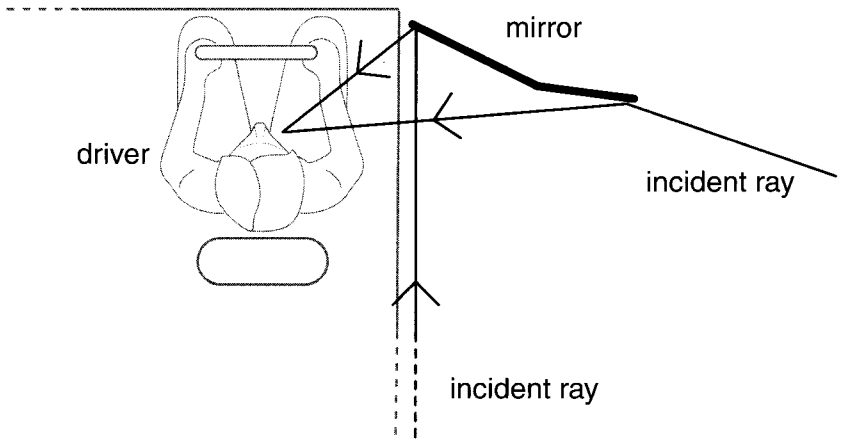

Fig. 8.3

Suggest **one** advantage and **one** disadvantage of this design of mirror compared with that shown in Fig. 8.2.

advantage .....

disadvantage .....

[2]

(c) The rear surface of the mirror can be heated electrically to clear frost and demist the mirror. A current I is passed through the reflecting alloy at the back of the mirror, as shown in Fig. 8.4.

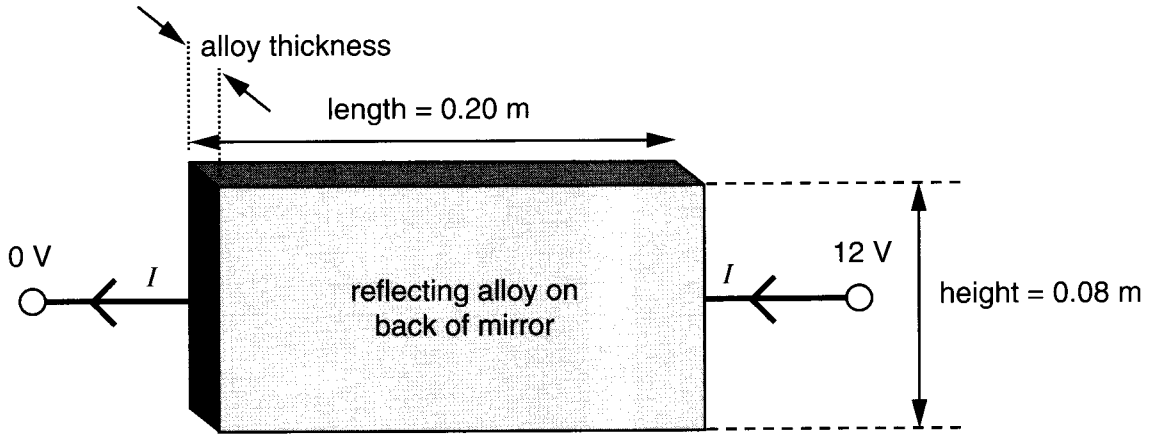

Fig. 8.4

(i) The heater dissipates 50 W from the 12 V car battery.

Show that the current I drawn by the heater is about 4 A.

[2]

(ii) Show that the conductance G of the heater is about 0.3 S.

[2]

(iii) The dimensions of the mirror are length = 0.20 m and height = 0.08 m as shown in Fig. 8.4.

Calculate the thickness of the reflecting alloy film used to heat the mirror.

conductivity of reflecting alloy = $3.1 \times 10^5\,\text{S m}^{-1}$

thickness = ... m [3]

[Total: 10]