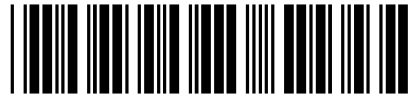


OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

PHYSICS A

Wave Properties



2823/01

Friday

9 JUNE 2006

Morning

45 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Ruler (cm/mm)

Candidate
Name

Centre
Number

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Candidate
Number

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TIME 45 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre Number and Candidate number in the boxes above.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Pencil may be used for graphs and diagrams only.
- Do not write in the bar code. Do not write in the grey area between the pages.
- **DO NOT WRITE IN THE AREA OUTSIDE THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.**

FOR EXAMINER'S USE		
Qu.	Max	Mark
1	10	
2	8	
3	8	
4	9	
5	10	
TOTAL	45	

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

This question paper consists of 12 printed pages.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2} at^2$
	$v^2 = u^2 + 2as$
refractive index,	$n = \frac{1}{\sin C}$
capacitors in series,	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$
capacitors in parallel,	$C = C_1 + C_2 + \dots$
capacitor discharge,	$x = x_0 e^{-t/CR}$
pressure of an ideal gas,	$p = \frac{1}{3} \frac{Nm}{V} \langle c^2 \rangle$
radioactive decay,	$x = x_0 e^{-\lambda t}$
	$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
relativity factor,	$= \sqrt{1 - \frac{v^2}{c^2}}$
current,	$I = nAve$
nuclear radius,	$r = r_0 A^{1/3}$
sound intensity level,	$= 10 \lg \left(\frac{I}{I_0} \right)$

Answer **all** the questions.

- 1 (a) The refractive index n of a transparent medium is defined by the equation

$$n = \frac{c_i}{c_r}$$

State what is meant by

- (i) c_i
-
- (ii) c_r
-[2]

- (b) A ray of red laser light enters a transparent medium from air at an angle of incidence of 60° . The refractive index of the medium for this red light is 1.48.

- (i) In the space below, sketch a ray diagram to show how the ray is refracted as it enters the medium. Label your diagram to show
- the normal at the point of entry
 - the 60° angle of incidence
 - the angle of refraction r .

[3]

- (ii) Calculate the value of r .

$r = \dots\dots\dots^\circ$ [2]

- (iii) In air, the wavelength of the light is 6.48×10^{-7} m and its frequency is 4.63×10^{14} Hz. Determine the wavelength and frequency of this light in the **medium**.

wavelength =m

frequency = Hz
[3]

[Total: 10]

- 2 (a) Fig. 2.1 shows three rays of light **X**, **Y** and **Z** leaving a point light source inside a glass block. Ray **Y** meets the glass/air interface at the critical angle **C**.

- (i) Label **C** on Fig. 2.1. [1]

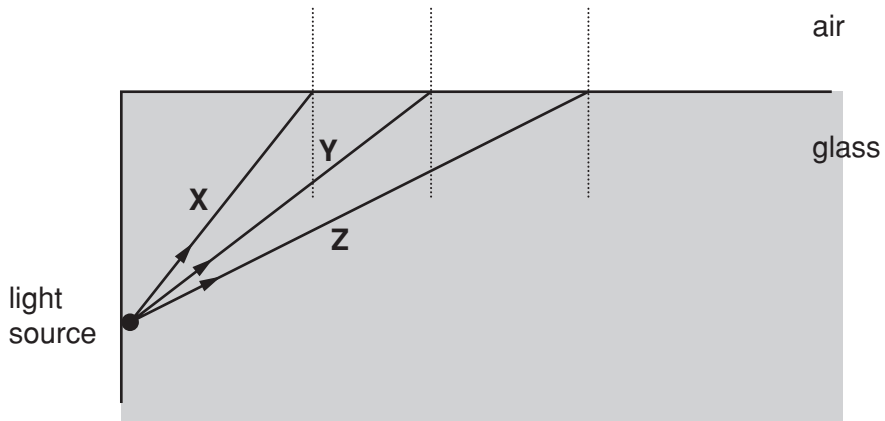


Fig. 2.1

- (ii) On Fig. 2.1, continue rays **X**, **Y** and **Z** to show their paths after they meet the interface. [3]

- (iii) The value of **C** is 44° . Calculate the refractive index n of the glass.

$n = \dots\dots\dots$ [2]

- (b) State and describe a practical application of the total internal reflection of light.

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[Total: 8]

- 4 (a) Draw a labelled diagram to show the arrangement that you would use to produce, on a screen, a double-slit interference pattern for light.

[1]

In order to see the interference pattern clearly in a darkened room, suggest suitable values for

- (i) the distance from the double-slit to the screen

distance =

- (ii) the distance between the centres of the slits in the double-slit.

distance =

[2]

- (b) Fig. 4.1 shows the light and dark fringes in a typical double-slit interference pattern. The diagram is drawn to full scale.



Fig. 4.1

- (i) By taking measurements directly from Fig. 4.1, determine the fringe separation x .

$x = \dots\dots\dots$ mm [1]

(ii) Fringe **O** is the bright fringe at the centre of the pattern, **A** is a bright fringe and **B** is a dark fringe. For each of these fringes, state in terms of the wavelength λ , the value of the path difference for light coming from each slit.

fringe **O** path difference =

fringe **A** path difference =

fringe **B** path difference =

[3]

(c) Use the formula for double-slit interference to explain how the fringe separation would change if blue light were used instead of red light.

.....
.....
.....[2]

[Total: 9]

5 (a) State **two** differences between sound and light waves.

- 1.
- 2. [2]

(b) The diffraction of waves can be demonstrated using a ripple tank.

(i) Describe how plane, transverse water waves can be produced in the ripple tank.

-
- [2]

(ii) Explain how the wavelength of the water waves can be increased.

-
- [1]

(iii) State how the speed of the water waves can be reduced.

-
- [1]

(c) Fig. 5.1 shows plane water waves in a ripple tank approaching a narrow gap. On the diagram, draw the pattern of the wavefronts emerging from the gap. [2]

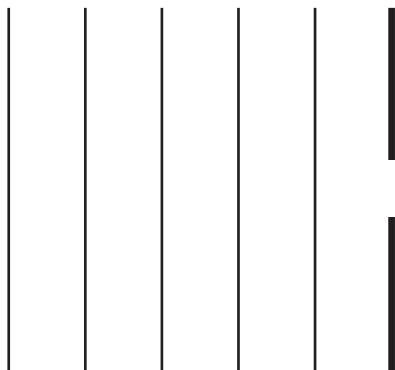


Fig. 5.1

(d) Explain why the diffraction of sound waves is much more likely to be noticeable than the diffraction of light.

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.....[2]

[Total: 10]

END OF QUESTION PAPER

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