OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

PHYSICS A 2823/01

Wave Properties

Wednesday **12 JANUARY 2005** Morning 45 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME 45 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.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu	Max.	Mark
1	6	
2	6	
3	7	
4	15	
5	11	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

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[Turn over

Data

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

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, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

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, $= 10 \lg \left(\frac{I}{I_0}\right)$

[Turn over

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 the meaning of the symbols c_i and c_r.

c_i .....

c_r .....[2]

(b) The refractive index of glycerol is 1.47. Calculate the angle of refraction r in the glycerol for light

(i) at an angle of incidence of 50°

r = ...°

(ii) at an angle of incidence of 0°.

r = ...°
[4]

[Total: 6]

2 **(a)** Describe, using fully labelled diagrams, what is meant by

(i) *critical angle*

.....

.....

.....

.....

.....

.....[2]

(ii) *total internal reflection.*

.....

.....

.....

.....

.....

.....[2]

(b) The refractive index of ruby is 1.76. Calculate the critical angle C for an air/ruby interface.

C = ...° [2]

[Total: 6]

[Turn over

3 **(a)** State an example of

(i) a transverse wave

.....[1]

(ii) a longitudinal wave.

.....[1]

(b) By referring to the nature of the vibrations involved, describe what is meant by

(i) a *transverse wave*

.....

.....[1]

(ii) a *longitudinal wave.*

.....

.....[1]

(c) Write **yes** or **no** in the spaces of the table below to indicate the wave phenomena associated with transverse and/or longitudinal waves. The first row in the table has already been completed.

wave phenomenon	transverse waves	longitudinal waves
reflection	YES	YES
refraction		
diffraction		
polarisation		

[3]

[Total: 7]

4 Fig. 4.1 shows, at a given instant, the surface of the water in a ripple tank when plane water waves are travelling from left to right.

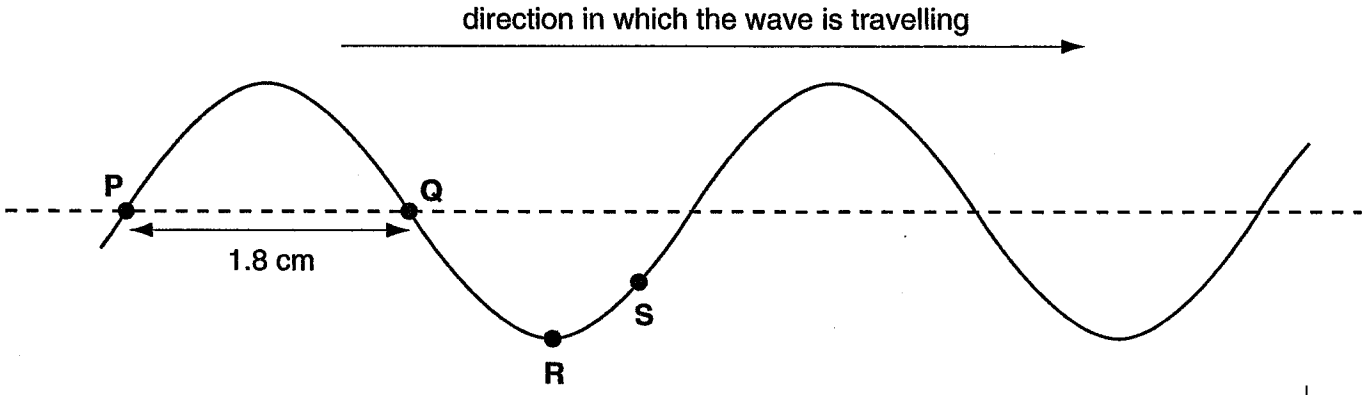

Fig. 4.1

(a) Show on Fig. 4.1

(i) the amplitude of the wave – label this **A** [1]

(ii) the wavelength – label this **λ**. [1]

(b) On Fig. 4.1

(i) draw the position of the wave a short time, about one-tenth of a period, later [2]

(ii) draw arrows to show the directions in which the particles at **Q** and **S** are moving during this short time. [2]

(c) State the phase difference between the movement of particles at **P** and **Q**.

phase difference = ...° [1]

(d) The frequency of the wave is 25 Hz and the distance between **P** and **Q** is 1.8 cm. Calculate

(i) the period of the wave

period = ...s [2]

(ii) the speed of the wave.

speed = ...m s^{-1} [3]

[Turn over

(e) **(i)** Suggest how the speed of the waves in the ripple tank could be changed.

.....

.....[1]

(ii) The frequency of the wave source is kept constant and the wave speed is halved. State what change occurs to the wavelength.

.....

.....

.....[2]

[Total: 15]

5 **(a)** State the term used to describe two wave sources that have a constant phase difference.

.....[1]

(b) Using suitable diagrams, state and explain what is meant by

- constructive interference
- destructive interference.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Describe an experiment to determine the wavelength of monochromatic light (i.e. light of one wavelength) using a double-slit of known slit separation.
Include in your answer

- a labelled diagram showing how the apparatus is arranged
- a list of the measurements required to determine the wavelength λ of the light
- the formula, with all symbols identified, that could be used to determine λ.

.....

.....

.....

.....

.....

.....[6]

[Total: 11]

END OF QUESTION PAPER

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