OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

PHYSICS A — 2823/01

Wave Properties

Tuesday **16 JANUARY 2001** Morning 1 hour

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

Candidate Name	Centre Number	Candidate Number

TIME 1 hour

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 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	15	
2	15	
3	10	
4	10	
5	10	
TOTAL	60	

This question paper consists of 12 printed pages.

For Examiner's Use

1 (a) Define the *refractive index* of a transparent medium.

....

....

....[1]

(b) Fig. 1.1 shows a ray of light **X** emitted by a point light source embedded in a glass block of refractive index 1.49. The angle of incidence of **X** at the glass/air surface is 30°.

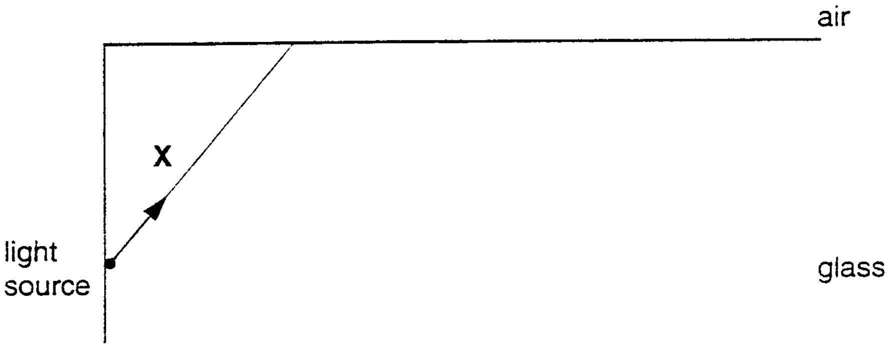

Fig. 1.1

(i) Calculate the angle of refraction of **X**.

angle of refraction = ... ° [3]

(ii) Complete Fig. 1.1 to show what happens to the ray **X** after it is incident at the glass/air interface. [2]

(iii) Calculate the critical angle at the glass/air interface.

critical angle = ... ° [2]

(iv) On Fig. 1.1 draw the complete path followed by another ray of light leaving the light source which reaches the glass/air interface at the critical angle (there is no need to measure the critical angle accurately but it should be labelled). [2]

For Examiner Use

(c) (i) Calculate the speed of light in glass of refractive index 1.49.

speed = ... $m\,s^{-1}$ [2]

(ii) Calculate the minimum time taken for a light pulse to travel from end to end along a straight glass fibre of length 50.0 km and refractive index 1.49.

time = ... s [2]

(iii) Suggest a reason why the time taken might be slightly greater than that calculated in **(ii)**.

....

....[1]

For Examiner's Use

2 **(a)** Define the following terms associated with waves.

(i) wavelength (λ)

....

....

....

(ii) frequency (f)

....

....

....

(iii) speed (v)

....

....

....
[4]

(b) Use these definitions to deduce the equation relating λ, f and v.

....

....

....

....[3]

For Examiner Use

(c) A source of sound vibrates with a period of 0.020 s and an amplitude of 1.2 cm.

(i) Use the grid in Fig. 2.1 to sketch a graph showing the variation with time *t* of the displacement *x* of the source. Label each axis with an appropriate numerical scale and draw two full cycles of the wave. [4]

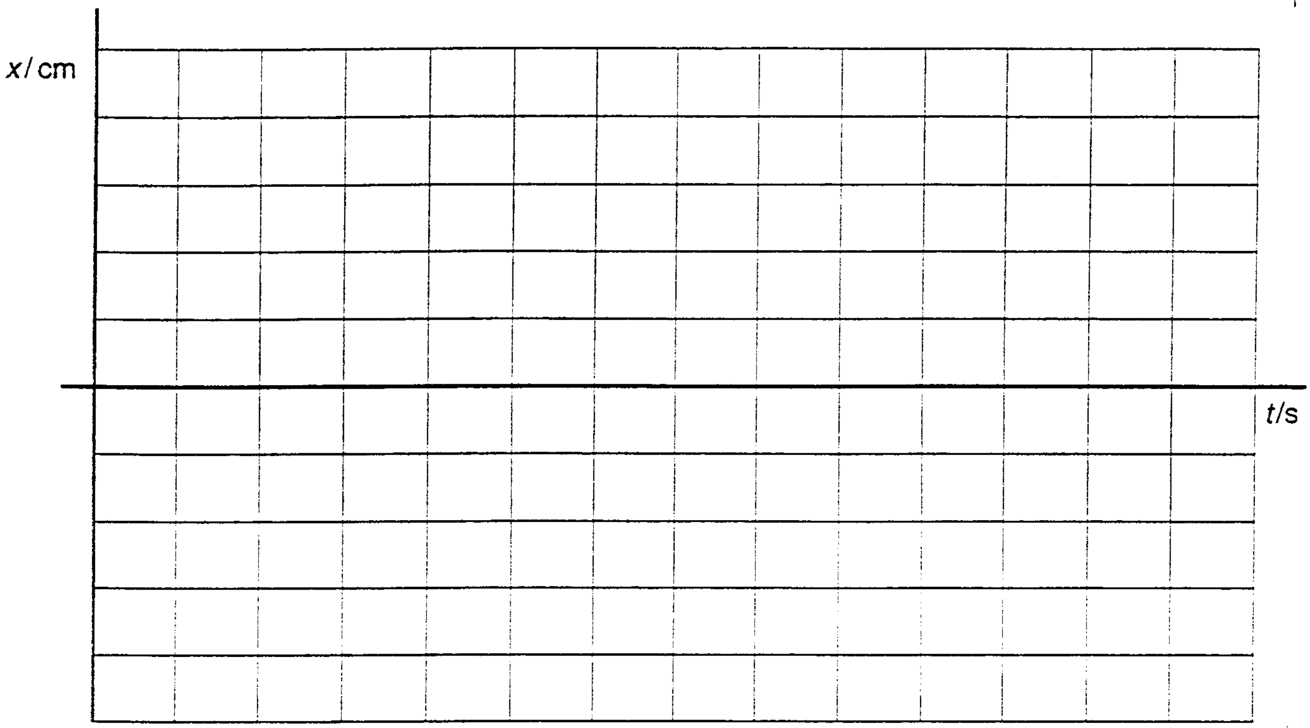

Fig. 2.1

(ii) Describe how the wave source moves to produce the sound waves.

....

....[1]

(iii) The speed of the sound waves is 340 m s^{-1}. Determine the wavelength.

wavelength = ... m [3]

[Turn over

For Examiner's Use

3 (a) (i) Explain with the aid of diagrams how the principle of superposition accounts for the constructive and destructive interference of waves.

1 constructive interference

....

....

....

....

2 destructive interference

....

....

....

....

[4]

(ii) In order to produce an observable interference pattern the wave sources must be coherent. Explain the meaning of coherence.

....

....[2]

(b) Fig. 3.1 shows a plan view of an experiment to demonstrate interference of microwaves. **T** is a microwave transmitter and **D** is a detector.

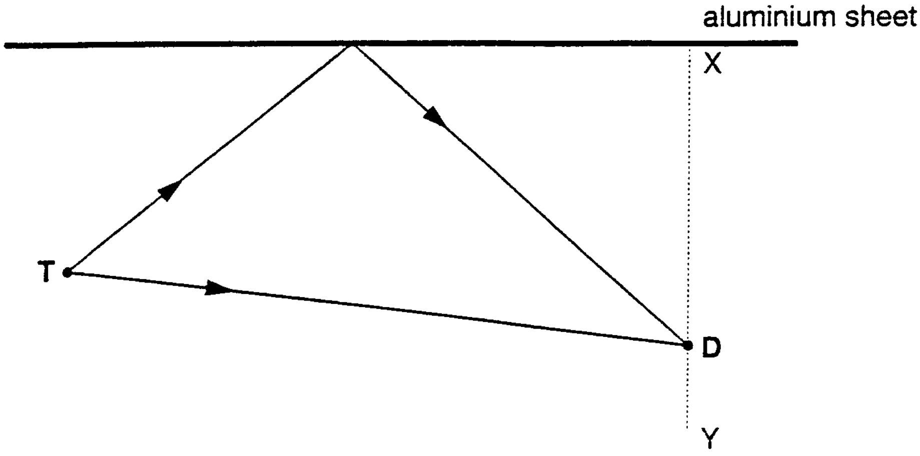

Fig. 3.1

Microwaves from **T** reach the detector **D** by two routes. Some travel directly to **D** in a straight line and others reach **D** after being reflected by the large aluminium sheet. When the detector is moved along the line XY perpendicular to the sheet the detector registers a sequence of maxima and minima.

(i) By referring to the path difference between the two sets of waves arriving at **D**, explain why maxima and minima are formed.

....

....

....

....[2]

(ii) Describe and explain how the separation between neighbouring maxima would change if microwaves with a shorter wavelength were used.

....

....

....

....[2]

[Turn over

For Examiner's Use

4 Fig. 4.1 shows a thin taut wire held horizontally between supports 0.40 m apart.

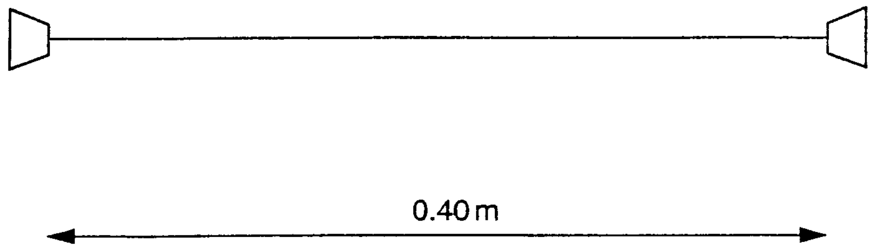

Fig. 4.1

(a) When the wire is plucked at its centre a standing wave is formed and the wire vibrates in its fundamental mode.

(i) Explain how the standing wave is formed.

....

....

....

....

....[2]

(ii) On Fig. 4.1, draw the fundamental mode of vibration. Label the position of any nodes with the letter **N** and any antinodes with the letter **A**. [3]

(iii) Determine the wavelength of this standing wave.

wavelength = ... m [2]

(b) (i) Describe how the wire could be made to vibrate with a frequency double that of the fundamental mode of vibration.

....

....

....[2]

(ii) On Fig. 4.2, sketch the appearance of this standing wave. [1]

Fig. 4.2

5 (a) Explain the meaning of the term *diffraction*.

....

....

....[2]

(b) (i) Describe how transverse water waves with a plane wavefront may be produced in a ripple tank.

....

....

....[2]

(ii) State how the wavelength of the waves could be shortened.

....

....[1]

(c) Fig. 5.1 shows plane water waves in a ripple tank approaching a narrow gap, the size of which is approximately the same as the wavelength of the waves.

(i) On Fig. 5.1, draw the pattern of the wavefronts emerging from the gap. [2]

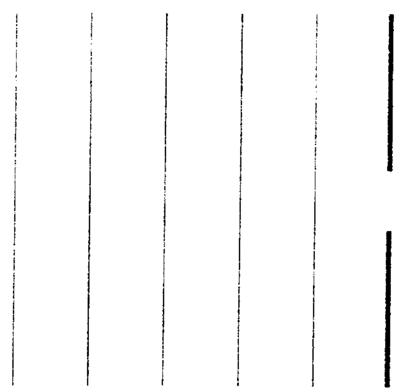

Fig. 5.1

For Examiner's Use

(ii) Describe how the pattern of wavefronts emerging from the gap would change if the size of the gap were significantly increased.

[2]

(iii) State why, under normal circumstances, light seems to travel in a straight line and does not appear to be diffracted.

....

....[1]