

NAME:

WAVES II

1. A double-slit interference experiment is set up using coherent red light as illustrated in Fig. 5.1.

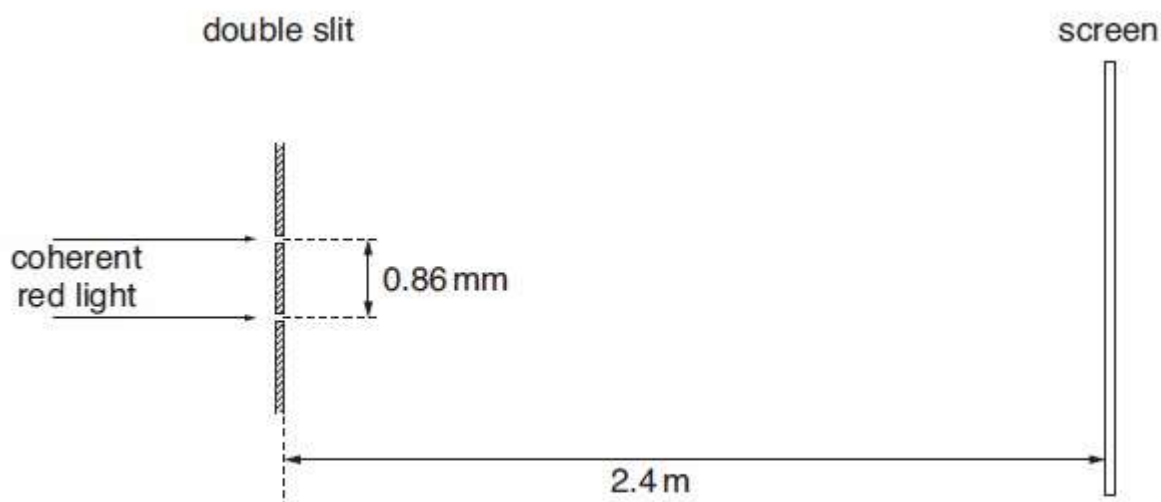


Fig. 5.1 (not to scale)

The separation of the slits is 0.86 mm.

The distance of the screen from the double slit is 2.4 m.

A series of light and dark fringes is observed on the screen.

(a) State what is meant by *coherent* light. [1m]

(b) Estimate the separation of the dark fringes on the screen. [3m]

Separation =mm

(c) Initially, the light passing through each slit has the same intensity. The intensity of light passing through one slit is now reduced. Suggest and explain the effect, if any, on the dark fringes observed on the screen.

[2m]

2. (a) Define *refractive index*.

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(1)

(b) In a certain medium, the speed of light of a particular frequency is $2.1 \times 10^8 \text{ m s}^{-1}$. Calculate the refractive index of the medium for this frequency.

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(2)

(c) With reference to your answer in (b), describe what is meant by optical dispersion.

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(3)

(Total 6 marks)

3. (i) Outline the conditions necessary for the formation of a standing (stationary) wave.

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(2)

- (ii) A horizontal tube, closed at one end, has some fine powder sprinkled along its length. A source S of sound is placed at the open end of the tube, as shown below.



The frequency of the source S is varied. Explain why, at a particular frequency, the powder is seen to form small equally-spaced heaps in the tube.

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(2)

- (iii) The mean separation of the heaps of powder in (b)(ii) is 9.3 cm when the frequency of the source S is 1800 Hz. Calculate the speed of sound in the tube.

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(2)

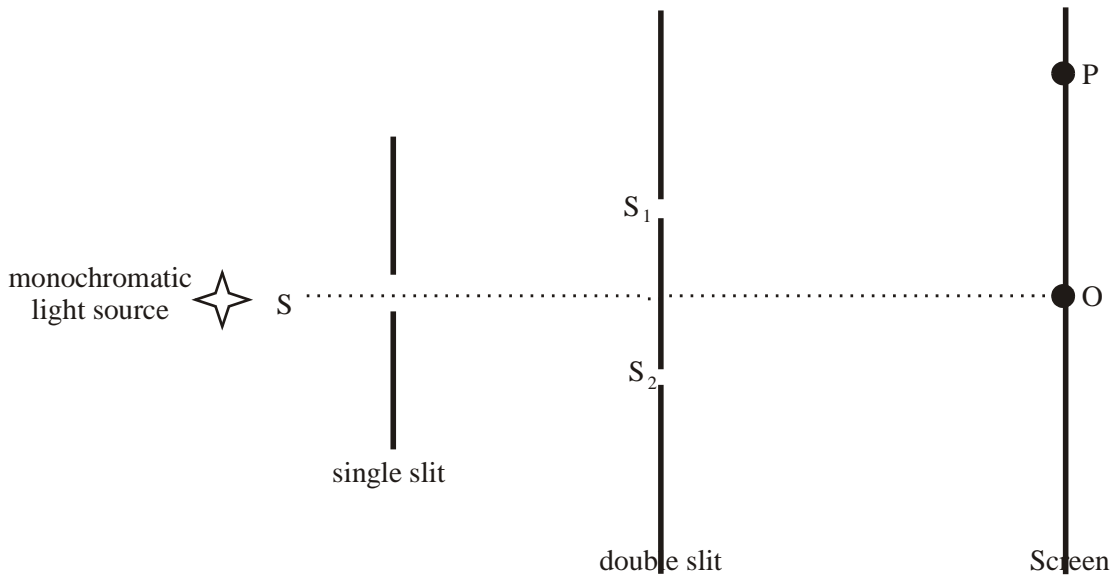
- (c) The experiment in (b)(ii) is repeated on a day when the temperature of the air in the tube is higher. The mean separation of the heaps is observed to have increased for the same frequency

of the source S. Deduce qualitatively the effect, if any, of temperature rise on the speed of the sound in the tube.

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(2)

4. The diagram below shows an arrangement (not to scale) for observing the interference pattern produced by the superposition of two light waves.



S_1 and S_2 are two very narrow slits. The single slit S ensures that the light leaving the slits S_1 and S_2 is coherent.

(i) Define *coherent*.

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(1)

(ii) Explain why the slits S_1 and S_2 need to be very narrow.

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(2)