

- 3 (a) The apparatus illustrated in Fig 3.1 is used to demonstrate two-source interference using light.

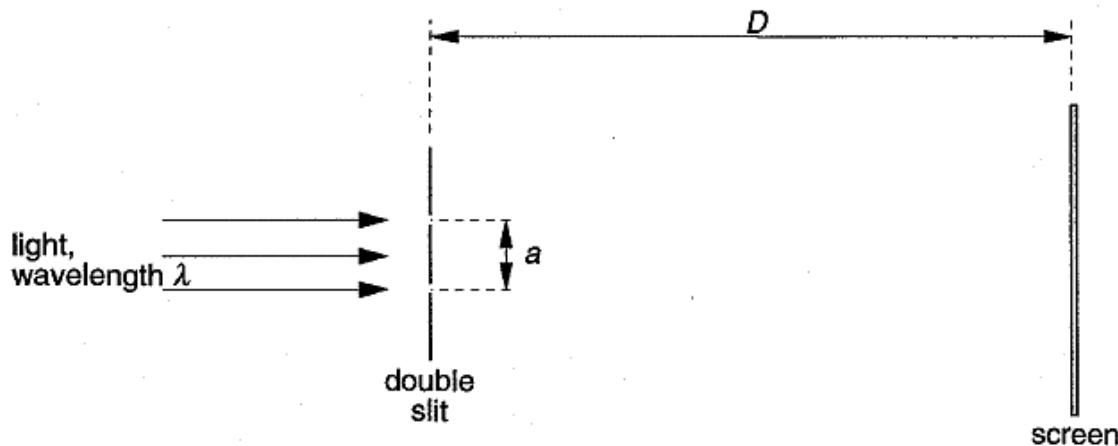


Fig. 3.1 (not drawn to scale)

The separation of the two slits in the double slit arrangement is a and the interference fringes are viewed on a screen at a distance D from the double slit. When light of wavelength λ is incident on the double slit, the separation of the bright fringes on the screen is x .

State and explain the effect, if any, on the separation of the fringes and on the contrast between the bright and dark fringes when the incident light is polarised into a single plane before reaching the double slits.

Separation:

Contrast:

..... [2]

- (b) In Fig. 3.2, T_1 and T_2 are two adjacent transmitters 1.0 m apart with a receiver aerial R at mid-point between them. The transmitters are set up to emit vertically polarised coherent microwaves of wavelength 3.0 cm and of equal amplitudes A .

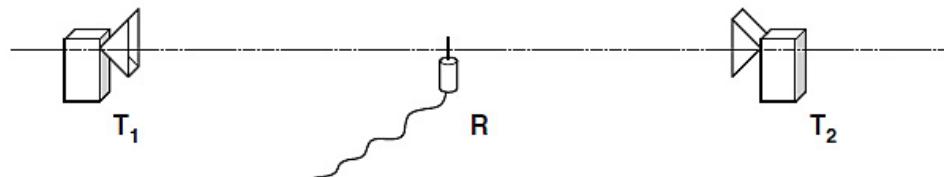


Fig. 3.2

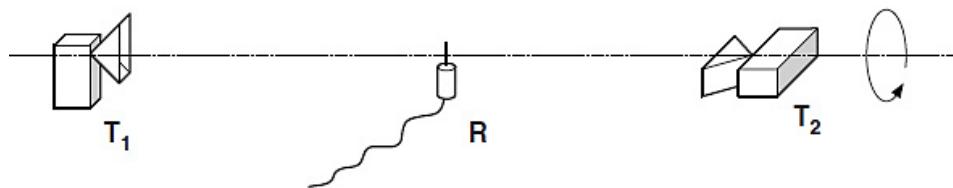
- (i) A student observes that the signal at the receiver R falls from maximum to zero when receiver R moved 0.75 cm towards a transmitter.

Explain these observations. Include any quantitative calculations.

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[3]

- (ii) With R at the mid-point between T_1 and T_2 , the student rotates T_2 through 90° about an axis through T_1 and T_2 as shown in Fig. 3.3 such that T_2 emits horizontally polarised wave.



Fig, 3.3

The student observes that the intensity of the signal at R is halved.

The detected signal remains the same when R is moved 0.75 cm towards a transmitter.

By considering the Principle of Superposition, explain these observations. Include any quantitative calculations.

[3]

- (c) Visible white light, which has a range for wavelengths of red light of 700 nm to violet light of 400 nm, is passed through a diffraction grating of 200 lines per mm as shown in the Fig. 3.4. A screen was placed 3.00 m from the diffraction grating and is perpendicular to the incident beam of white light.

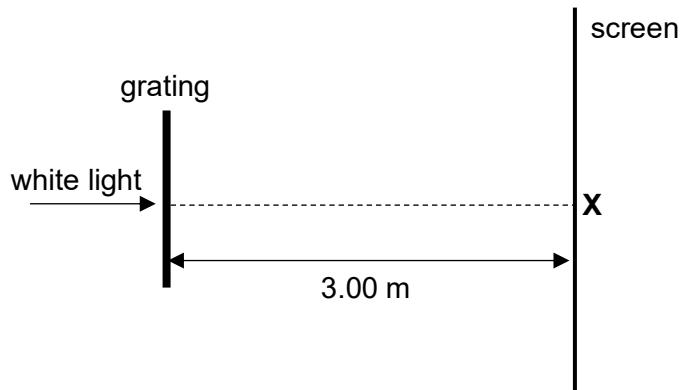


Fig. 3.4

- (i) Explain why point X appears white.

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..... [1]

- (ii) Determine the range of distances from X for the 1st order of fringes observed.

..... m to m [2]

- (iii) Show with calculation whether the 3rd order fringes overlaps with the 2nd order fringes.

..... [2]