

- 5 (a) Explain what is meant by *destructive interference*.

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[2]

- (b) Fig. 5.1 shows two coherent loudspeakers  $S_1$  and  $S_2$  placed 4.0 m apart in an open field on a calm day. D is a detector placed in the same horizontal plane as the loudspeakers. D is placed 12.0 m away from  $S_2$ . When the loudspeakers are switched on, sound of frequency 1780 Hz is emitted from the two loudspeakers in antiphase. The lines  $S_1S_2$  and  $S_2D$  are perpendicular to each other.

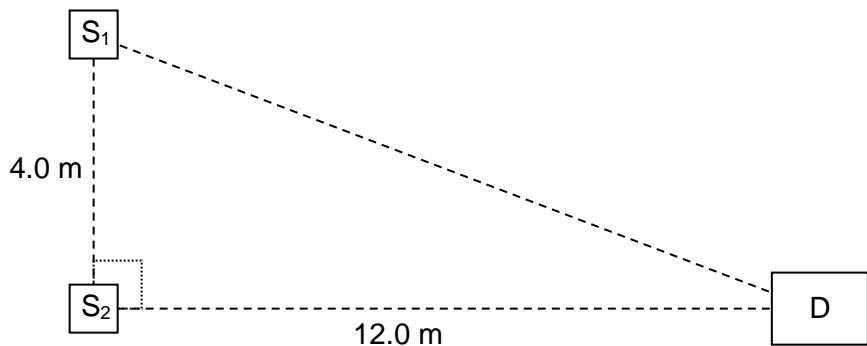


Fig. 5.1

- (i) Given that the speed of sound in air is  $330 \text{ m s}^{-1}$ , calculate the wavelength  $\lambda$  of the sound emitted from  $S_1$  and  $S_2$ .

$$\lambda = \dots \text{ m} \quad [1]$$

- (ii) Calculate the path difference, in terms of  $\lambda$ , between the sound waves reaching D from  $S_1$  and  $S_2$ . You may assume that the two loudspeakers and the detector are point objects.

$$\text{path difference} = \dots \lambda \quad [2]$$

- (iii) Hence, state and explain whether a loud sound would be heard at D.

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[2]

- (c) Light of wavelength 590 nm is incident on a diffraction grating with slits of separation  $1.6 \times 10^{-6}$  m.

- (i) Determine the maximum order of the interference pattern that will be observed on a screen placed in front of the grating.

maximum order = ..... [2]

- (ii) Another diffraction grating of the same slit separation is placed in front of the original grating such that their slits are perpendicular to one another as shown in Fig. 5.2. A 2-dimensional pattern of bright spots is formed on the screen.

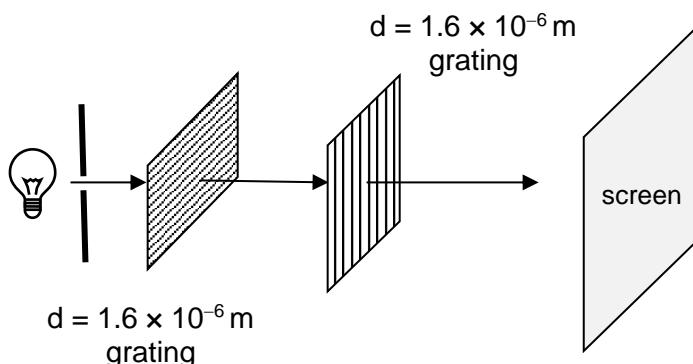


Fig. 5.2

On Fig. 5.3, sketch the pattern obtained, showing clearly the relative separation of the spots.

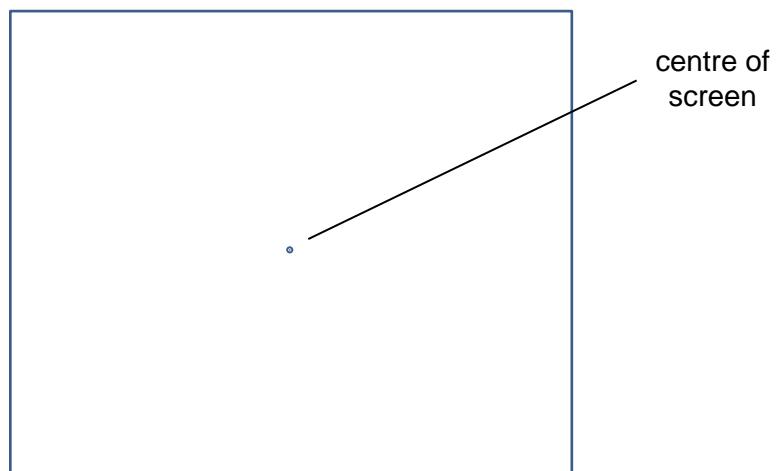


Fig. 5.3

[2]

- (iii) State how your answer in (c)(ii) will change when a blue light source is used.

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[1]