3 Fig. 3.1 shows two coherent loudspeakers S_1 and S_2 placed 4.0 m apart in an open field. 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.

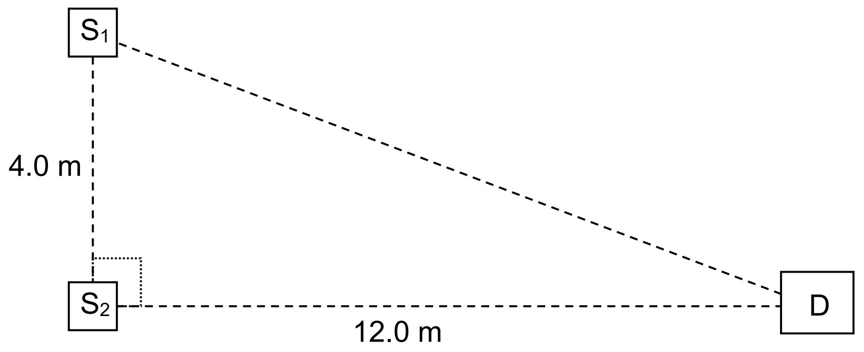

Fig. 3.1

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

λ = ………………….. m [1]

(b) Calculate the path difference, in terms of λ, 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.

path difference = ………………….. λ [2]

(c) By considering the phase difference between the sound waves reaching D from S_1 and S_2, explain whether D would detect a minimum or maximum intensity.

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…………………………………………………………………………………… [2]

(d) As the frequency of the sound from S_1 and S_2 is gradually increased from 1780 Hz to a value f_1, the resultant intensity at D goes through a series of maxima and minima. It eventually detects 2 complete cycles of change in sound intensity.

Calculate the frequency f_1 at which the second complete cycle of change in sound intensity is detected.

f_1 = ………………….. Hz [3]