Section B

Answer **one** question from this Section in the spaces provided.

7 **(a)** Distinguish between *longitudinal* and *transverse* progressive waves.

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……

……

…….. [2]

(b) The intensity of sound from a loudspeaker as perceived by an observer is the same at a distance *D* from it in all directions. The amplitude of the sound heard at this distance is *A*.

The power of the loudspeaker is now halved.

(i) Deduce the value of the new amplitude in terms of *A* when the observer remains at the same distance *D* from the source.

amplitude = ……..……. [2]

(ii) Determine, in terms of *D*, the new distance from the loudspeaker that the observer should be at if he wishes the sound to seem as loud as before.

distance = ……..……. [2]

(c) Fig. 7.1 shows two loudspeakers S and T separated by a distance of 0.50 m. They are connected to separate signal generators. The line OY is at a distance *d* from the loudspeakers and point O is equidistant from loudspeakers S and T.

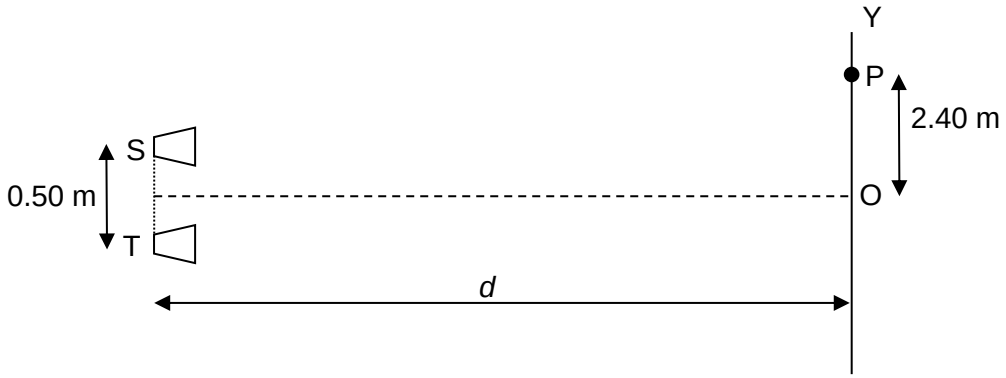
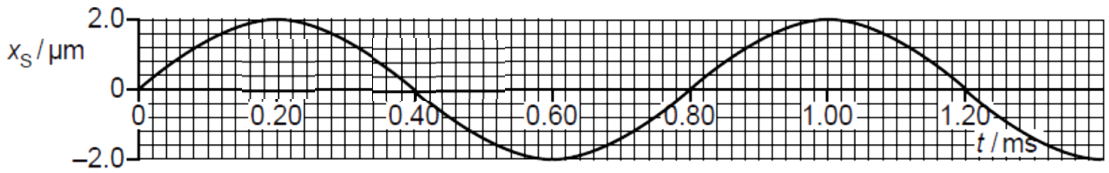


Fig. 7.1 (not to scale)

Fig. 7.2 shows the sound waves emitted by S and T having displacements x_S and x_T respectively at point P. Point P is the position of the first minimum at distance 2.40 m from point O. The graphs show the variation with time *t* of each of these displacements.

Wave arriving at P from loudspeaker S only.



Wave arriving at P from loudspeaker T only.

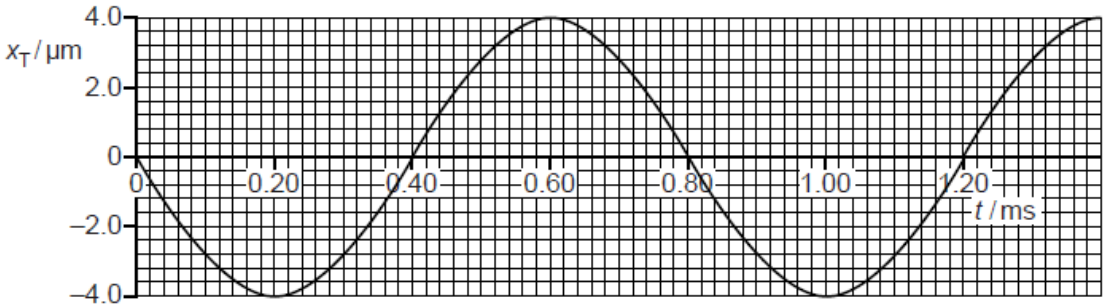


Fig.7.2

(i) With reference to Fig. 7.2, explain whether the two sound waves are coherent.

……..

…….... [1]

(ii) Explain why the sound heard at P is of non-zero intensity.

……

……

…….. [2]

(iii) The intensity of the waves arriving at P from source S only has the intensity I. State, in terms of I, the intensity of the combined sound when waves from both sources S and T arrive at P.

intensity = …….. [1]

(iv) Use data from Fig. 7.2 to determine the wavelength of the sound waves emitted from the loudspeakers. The speed of sound is 330 m s^{-1}.

wavelength = ... m [2]

(d) Based on the layout in Fig. 7.1, a student drew a more detailed version with angle θ shown in Fig. 7.3. The length TQ represents the path difference between the two loudspeakers to P. This is to help him with the steps towards determining the value of d.

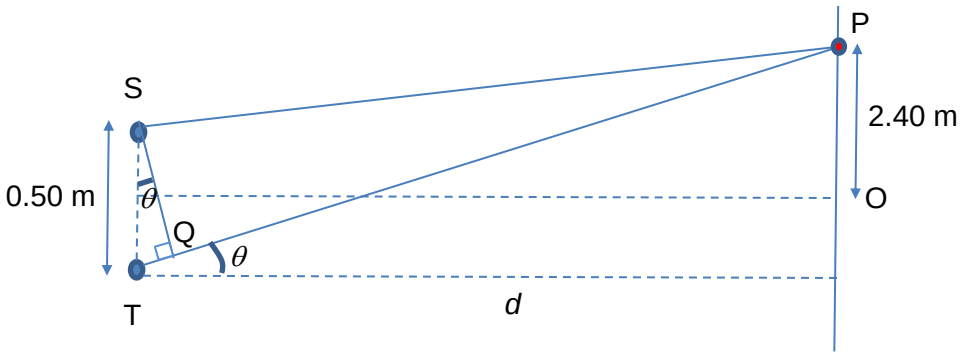


Fig. 7.3 (not to scale)

Note that point O is also a position of minimum intensity.

(i) State the value of the path difference between TP and SP.

path difference = …….. m [1]

(ii) Hence, determine

1. the angle θ.

angle θ = …… ° [2]

2. the value of *d*.

d = ... m [2]

(iii) To find the distance *d* in Fig. 7.3, another student suggested using the Young's double-slit interference formula,

$$\text{wavelength } \lambda = \frac{ax}{d}$$

where *a* = slit separation

x = fringe separation

d = perpendicular distance between the double slit and screen

Explain why it is wrong to do so for this case.

……

……

…… [2]

(e) Another student noted that the sound from the loudspeakers travelled through a metal grill fence like those shown in Fig. 7.4. This fence is situated between the loudspeakers and the line OY.

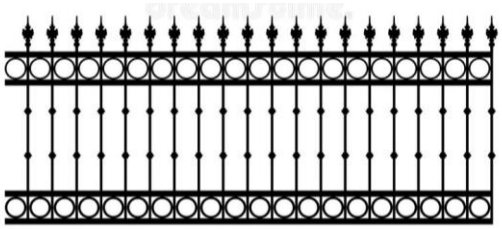


Fig. 7.4

He then suggested that the variation in the sound intensity across the line OY can be attributed to the effects of polarisation.

Suggest how polarisation could not be the contributing factor.

……

…….. [1]

[Total: 20]