4 (a) A signal generator, loudspeaker, microphone, oscilloscope and metal plate are used to investigate stationary waves, as shown in Fig. 4.1.

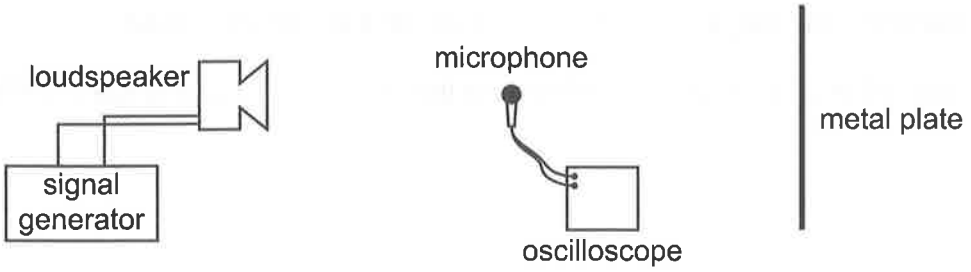

Fig. 4.1

The loudspeaker emits sound of a single frequency. The microphone is connected to the oscilloscope.

(i) Describe how a stationary wave is formed between the loudspeaker and the metal plate.

.....

.....

.....

..... [2]

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(ii) The waveform obtained on the oscilloscope is shown in Fig. 4.2.

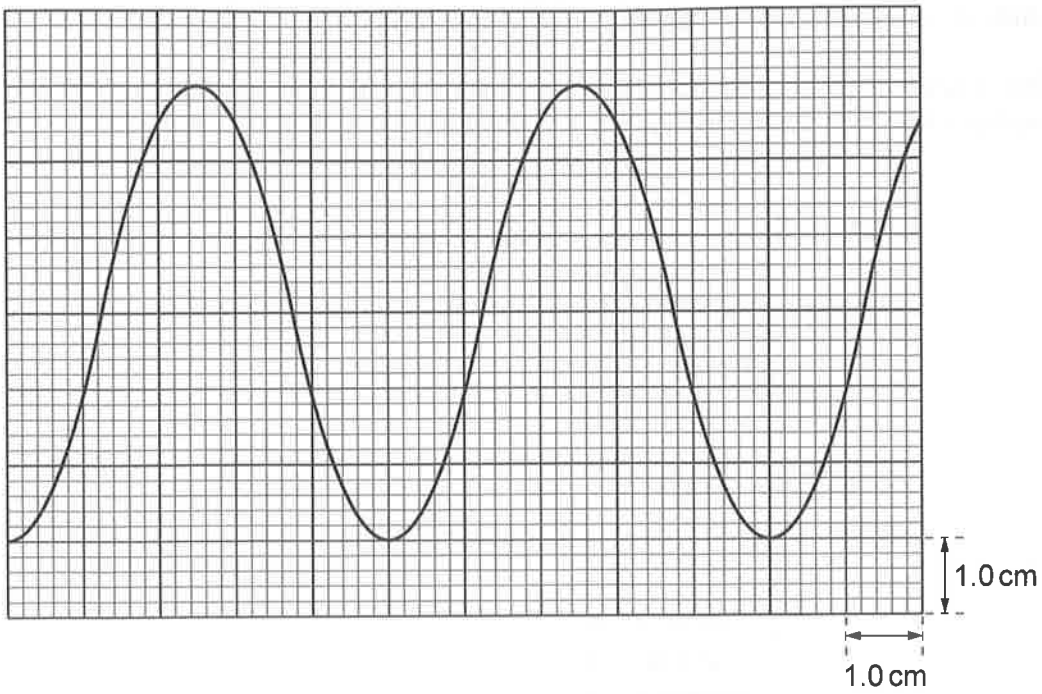

Fig. 4.2

The time base setting on the oscilloscope is $0.50\,\text{ms}\,\text{cm}^{-1}$.

Use Fig. 4.2 to show that the frequency of the sound wave is 400 Hz.

[2]

(iii) The speed of sound is $340\,\text{m}\,\text{s}^{-1}$.

Calculate the distance between adjacent nodes of the stationary wave.

distance = ... m [2]

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(b) Two loudspeakers X and Y are connected to a signal generator and used to investigate interference. The loudspeakers emit sound waves of wavelength 0.20 m. The sound waves emitted from the two loudspeakers are in phase and have equal intensities.

The sound at point P is detected. Point P is 1.4 m from loudspeaker X and 1.8 m from loudspeaker Y, as shown in Fig. 4.3.

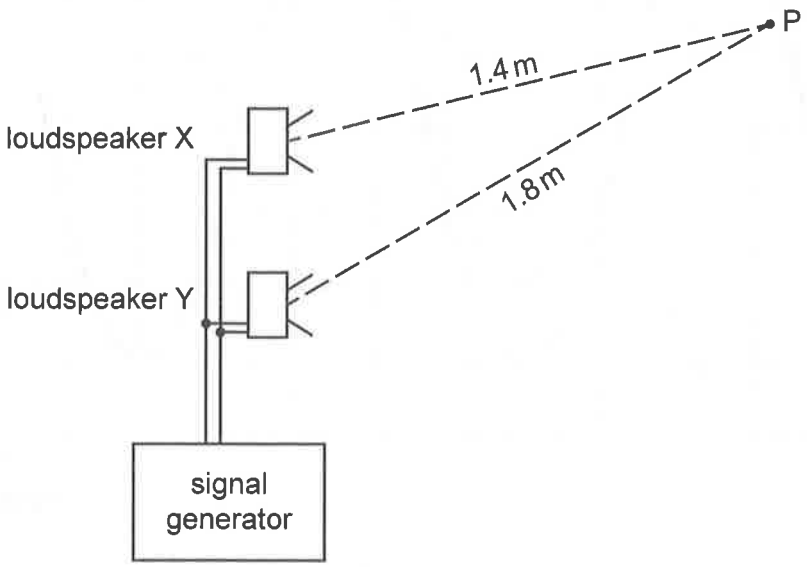

Fig. 4.3 (not to scale)

(i) State and explain whether the intensity of the sound at P is a maximum or a minimum.

.....

.....

..... [2]

(ii) The loudspeakers can be treated as point sources. The intensity at P of the sound from loudspeaker X is $4.5 \times 10^{-6}\,\text{W m}^{-2}$.

Calculate the intensity at P of the sound from loudspeaker Y.

intensity = ... W m^{-2} [2]

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(iii) For the sound waves at P, calculate the ratio:

$$\frac{\text{amplitude of wave from loudspeaker X}}{\text{amplitude of wave from loudspeaker Y}}.$$

ratio = ... [2]

[Total: 12]

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