6 **(a)** State what is meant by the *wavelength* of a progressive wave.

....

.... [1]

(b) A cathode-ray oscilloscope (CRO) is used to analyse a sound wave. The screen of the CRO is shown in Fig. 6.1.

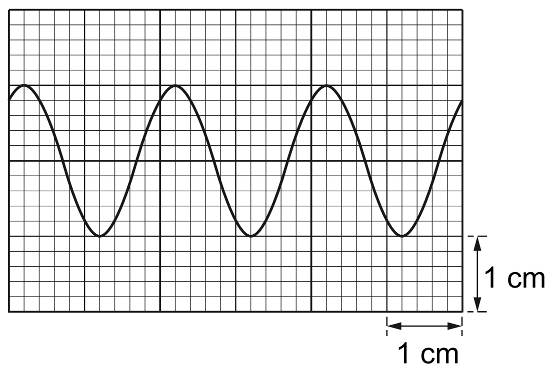

Fig. 6.1

The time-base setting of the CRO is 2.5 ms cm^{-1}.

Determine the frequency of the sound wave.

frequency = ...Hz

[1]

(c) The source emitting the sound in **(b)** is placed near the bottom opening of a vertical tube of length 0.80m. The tube is open at both ends, as shown in Fig. 6.2.

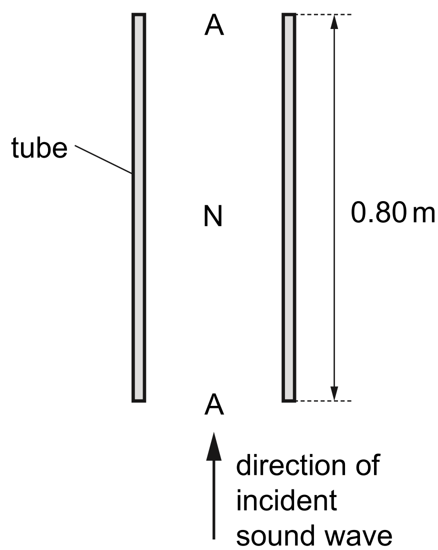

Fig. 6.2

A stationary wave is then formed in the air column in the tube with antinodes A at both ends and a node N at the midpoint.

(i) Explain how the stationary wave is formed from the incident sound wave.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

[2]

(ii) On Fig. 6.3, sketch a graph to show the variation of the amplitude of the stationary wave with height h above the bottom of the tube.

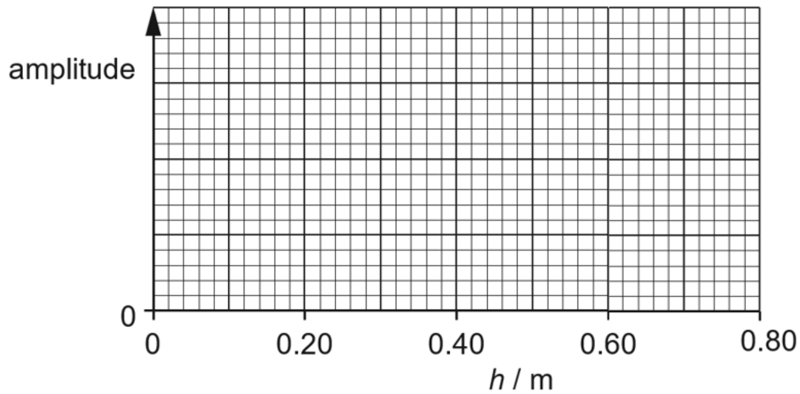

Fig. 6.3

[2]

(iii) For the stationary wave, state

1. the direction of the oscillations of an air particle at a height of 0.15 m above the bottom of the tube

....

[1]

2. the phase difference between the oscillations of a particle at a height of 0.10 m and a particle at a height of 0.20 m above the bottom of the tube.

phase difference = ... ° [1]

(iv) Determine the wavelength of the sound wave.

wavelength = ... m

[1]

(d) The source emitting the sound in **(b)** is then placed at point A as shown in Fig. 6.4.

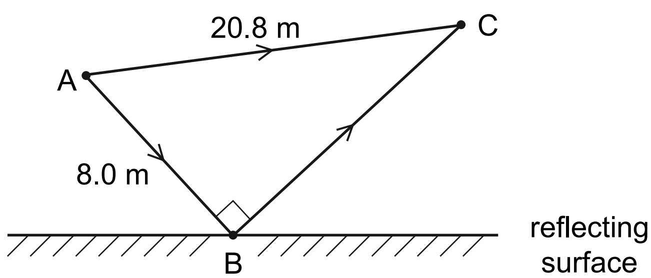

Fig. 6.4 (not to scale)

The sound waves travel from the source to point C along two different paths, AC and ABC. Distance AB is 8.0 m and distance AC is 20.8 m. Angle ABC is 90°.

Assume that there is no phase change of the sound wave due to the reflection at point B.

(i) Show that the waves meeting at C have a path difference of 6.4 m

[1]

(i) Explain why an intensity maximum is detected at point C.

………………………………………………………………………………………….…

………………………………………………………………………………………….…

………………………………………………………………………………………….…..

[2]

(ii) Determine the difference between the time taken for the sound waves to travel from the source to point C along the two different paths.

time difference = ...s [2]

(iii) The wavelength of the sound is gradually increased. Calculate the wavelength of the sound when an intensity maximum is next detected at point C.

wavelength = ...m [2]

(e) Fig. 6.5 shows an ideal polarizer A arranged so that its polarizing direction is vertical. Polariser B is oriented with its plane parallel to that of A and with its polarizing direction at 45° to the vertical.

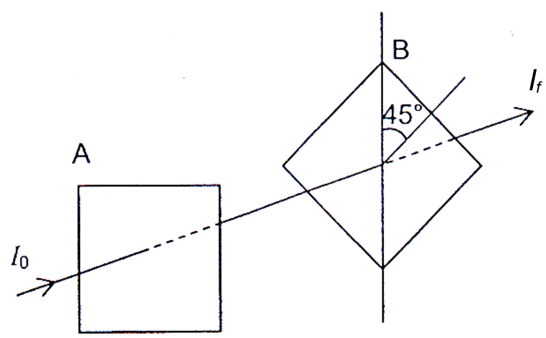

Fig. 6.5 a

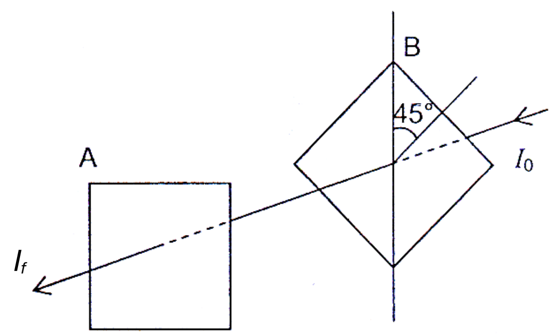

Fig. 6.5 b

A beam of vertically-polarised light, of initial intensity I_o, passes through the polarisers in turn.

Determine the intensity I_f and the orientation of the emergent beam when the beam passes through the polarizer system

(i) in the direction from A to B (Fig. 6.5a), intensity I_f = ...

orientation to the vertical =.. ^{o} [2]

(ii) in the direction from B to A (Fig. 6.5b).

intensity I_f = ...

orientation to the vertical =.. ^{o} [2]

[Total: 20]