

- 5 (a) A vertical tube of length 0.60 m is open at both ends, as shown in Fig. 5.1.

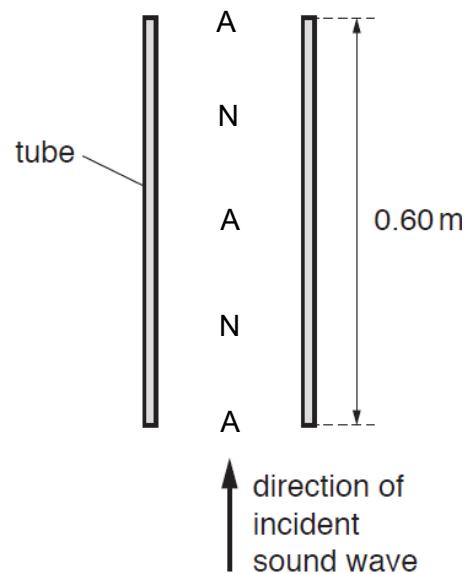


Fig. 5.1

An incident sinusoidal sound wave of a single frequency travels up the tube. A stationary wave is then formed in the air column in the tube with antinodes A and nodes N.

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

[2]

- (ii) On Fig. 5.2, sketch a graph to show the variation of the amplitude of the stationary wave with height h above the bottom of the tube.

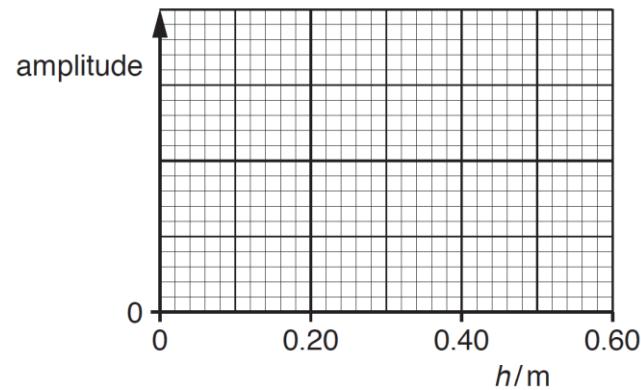


Fig. 5.2

[2]

(iii) For the stationary wave, state

1. the direction of the oscillations of an air particle at a height of 0.30 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) The speed of the sound wave is 340 m s^{-1} . The frequency of the sound wave is gradually increased.

Determine the frequency of the wave when a stationary wave is next formed.

frequency =Hz [2]

- (b) (i) Monochromatic light is incident on a diffraction grating. Describe the diffraction of the light waves as they pass through the grating.

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..... [1]

- (ii) A parallel beam of light consists of two wavelengths 540 nm and 630 nm. The light is incident normally on a diffraction grating. Third-order diffraction maxima are produced for each of the two wavelengths. No higher orders are produced for either wavelength.

Determine the smallest possible line spacing d of the diffraction grating.

d =m [2]

- (iii) The beam of light in (b)(ii) is replaced by a beam of blue light incident on the same diffraction grating.

State and explain whether a third-order diffraction maximum is produced for this blue light.

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[Total: 12]

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