**4** **(a)** Sound waves are longitudinal waves. By reference to the direction of propagation of energy, state what is meant by a *longitudinal* wave.

.....

.....[1]

**(b)** A stationary sound wave in air has amplitude $A$. In an experiment, a detector is used to determine $A^2$. The variation of $A^2$ with distance $x$ along the wave is shown in Fig. 4.1.

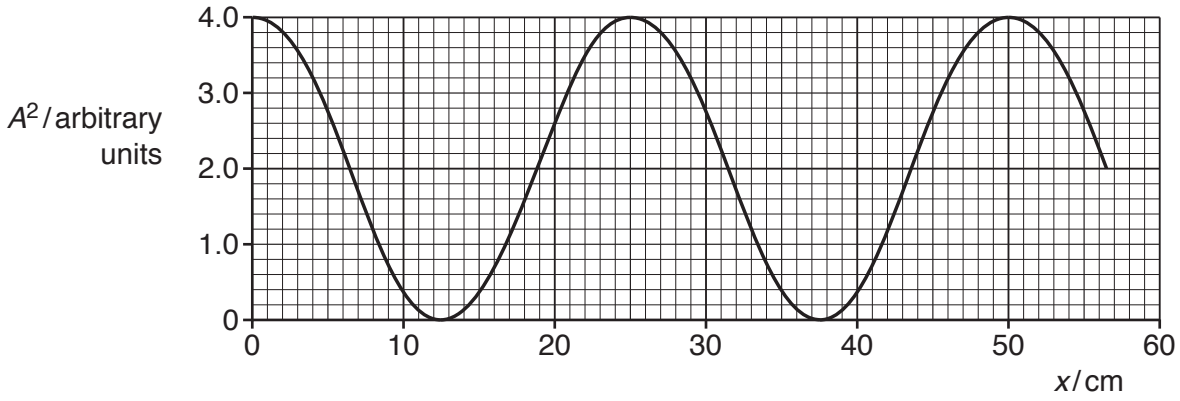


**Fig. 4.1**

**(i)** State the phase difference between the vibrations of an air particle at $x = 25\,\text{cm}$ and the vibrations of an air particle at $x = 50\,\text{cm}$.

phase difference = ..... ° [1]

**(ii)** The speed of the sound in the air is $330\,\text{m s}^{-1}$. Determine the frequency of the sound wave.

frequency = ..... Hz [3]

**(iii)** Determine the ratio

$$\frac{\text{amplitude } A \text{ of wave at } x = 20\,\text{cm}}{\text{amplitude } A \text{ of wave at } x = 25\,\text{cm}}.$$

ratio = .....[2]

[Total: 7]