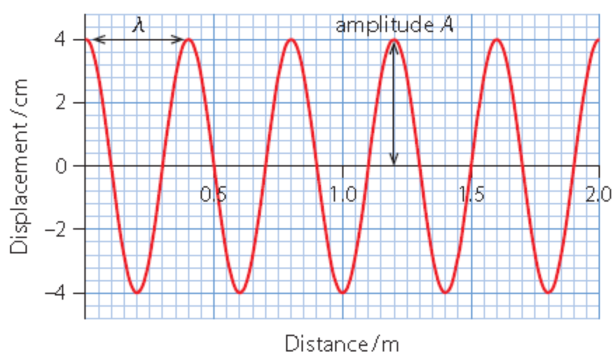
Answers to test yourself questions

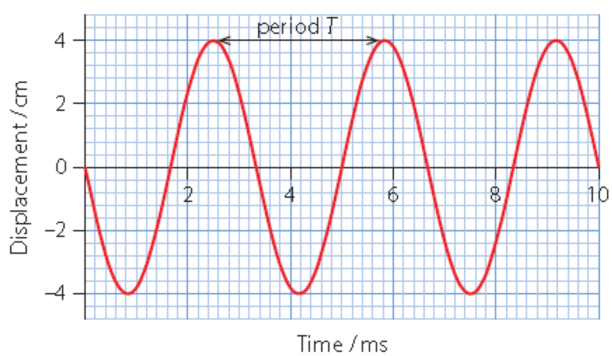
4.2 Travelling waves

6 The delay time between you seeing the person next to you stand up and you standing up and the number density of the people i.e. how many people per unit meter. For a fixed delay time, the closer the people are the faster the wave.

7 There is a disturbance that travels through the lie of dominoes just as a disturbance travels through a medium when a wave is present. You can increase the speed by placing them closer together. An experiment to investigate this might be to place a number of dominoes on a line of fixed length such that the dominoes are a fixed distance d apart. We must give the same initial push to the first domino (for example using a pendulum that is released from a fixed height and strikes the domino at the same place. We then measure time form when the first domino is hit until the last one is hit. Dividing the fixed distance by the time taken gives the speed of the pulse. We can then repeat with a different domino separation and see how the speed depends on the separation d.

8 **a** Wavelength – the length of a full wave; the distance between two consecutive crests or troughs
b Period – the time needed to produce one full oscillation or wave
c Amplitude – the largest value of the displacement from equilibrium of an oscillation
d Crest – a point on a wave of maximum displacement
e Trough – a point on a wave of minimum displacement





9 a In wave motion displacement refers to the difference in the value of a quantity such as position, pressure, density etc when the wave is present and when the wave is absent.

b In a transverse wave the displacement is at right angles to the direction of energy transfer, in a longitudinal it is parallel to the energy transfer direction.

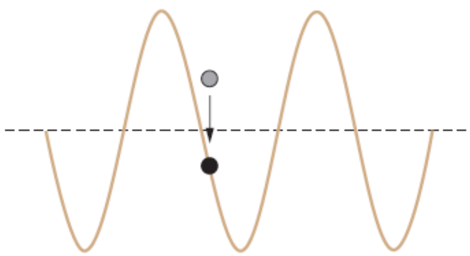
c The falling stone imparts kinetic energy to the water at the point of impact and so that water moves. It will continue moving (creating many ripples) until the energy is dissipated.

d We must recall that the intensity of a wave is proportional to the square of the amplitude. The amplitude will decrease for two reasons: first, some energy is bound to be dissipated as the wave moves away and so the amplitude has to decrease. Second, even in the absence of any energy losses, the amplitude will still decrease because the wavefronts get bigger as they move away from the point of impact of the ripple. The energy carried by the wave is now distributed on a longer wavefront and so the energy per unit wavefront length decreases. The amplitude must then decrease as well.

10 a From left to right: down, down, up.

b From left to right: up, up, down.

11

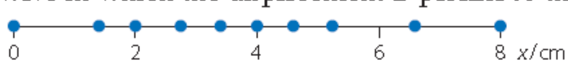


12 a $\lambda = \frac{v}{f} = \frac{330}{256} = 1.29$ m.

b $\lambda = \frac{v}{f} = \frac{330}{25 \times 10^3} = 1.32 \times 10^{-2}$ m.

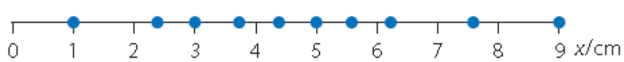
13 a A wave in which the displacement is parallel to the direction of energy transferred by the wave.

b i



ii At $x = 4.0$ cm

c i



ii The compression is now at $x = 5.0$ cm.

14 a $f = \frac{v}{\lambda} = \frac{340}{0.40} = 850$ Hz

b i A compression occurs at $x = 0.30$ m. Molecules just to the left of this point have positive displacement and so move to the right. Molecules just to the right move to the left creating the compression at $x = 0.30$ m.

ii By similar reasoning $x = 0.10$ m is a point where a rarefaction occurs.