Physics worksheet solutions – Transverse and longitudinal waves

Q1 State the difference between a transverse wave and a longitudinal wave.

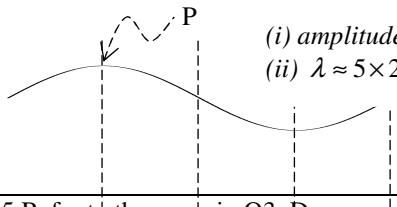
In a longitudinal wave the displacement of the particles in the medium is parallel to the direction of propagation of the wave.

In a transverse wave the displacement of the particles in the medium is perpendicular to the direction of propagation of the wave. For electromagnetic waves magnetic and electric fields are perpendicular to the direction of propagation.

Q2 Write T for transverse and L for longitudinal next to each of the following waves.

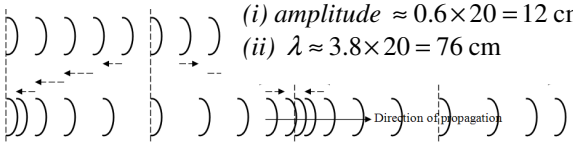
microwaves T *surface water waves* T *light* T
gamma rays T *sound waves in the air* L *X-rays* T
waves in a rope T *sound waves in water* L

Q3 The following picture has a scale of 1:20. It shows a section of a long rope with a wave travelling to the right. From the picture and with the help of a ruler find (i) the amplitude and (ii) the wavelength of the wave.



(i) amplitude $\approx 0.6\times 20 = 12$ cm
(ii) $\lambda \approx 5\times 20 = 100$ cm

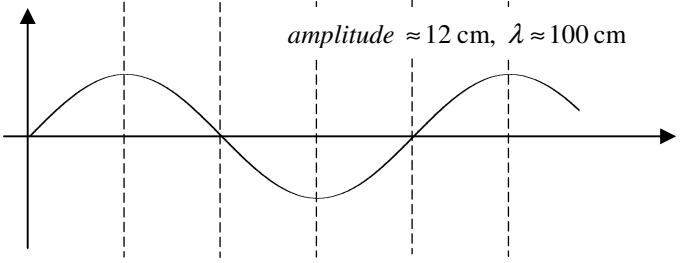
Q4 The following pictures have a scale of 1:20. The first picture shows a section of a stretched slinky spring. The second picture shows a wave travelling to the right in that section. From the pictures and with the help of a ruler estimate (i) the amplitude and (ii) the wavelength of the wave.



(i) amplitude $\approx 0.6\times 20 = 12$ cm
(ii) $\lambda \approx 3.8\times 20 = 76$ cm

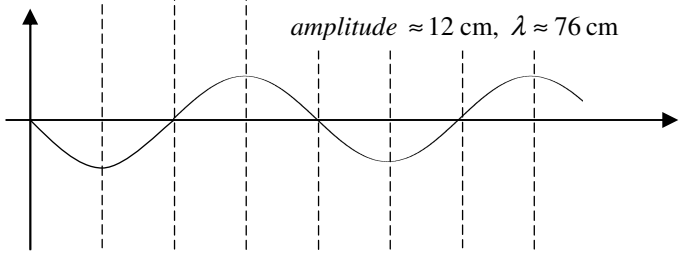
Q5 Refer to the wave in Q3. Draw a graph of particle (of the rope) displacement vs distance from the origin. Take the left end of the section as the origin.

amplitude ≈ 12 cm, $\lambda \approx 100$ cm



Q6 Refer to the wave in Q4. Draw a graph of particle (of the slinky spring) displacement vs distance from the origin. Take the left end of the section as the origin.

amplitude ≈ 12 cm, $\lambda \approx 76$ cm



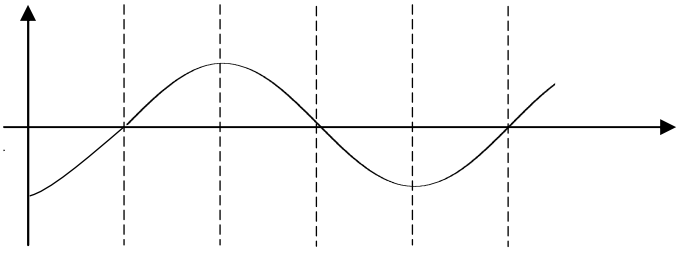
Q7 The wave in Q3 has a period of 0.5 s. Calculate the frequency and the speed of the wave.

$f = \frac{1}{T} = \frac{1}{0.5} = 2$ Hz, $v = f\lambda \approx 2\times 100 = 200$ cm s^{-1} (2 m s^{-1})

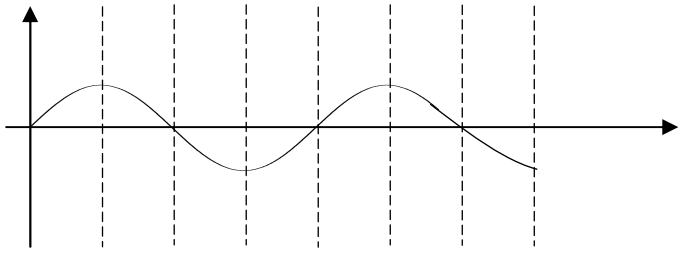
Q8 The wave in Q4 has a frequency of 0.8 Hz. Calculate the period and the speed of the wave.

$T = \frac{1}{f} = \frac{1}{0.8} = 1.25$ s, $v = f\lambda \approx 1.25\times 76 = 95$ cm s^{-1} (0.95 m s^{-1})

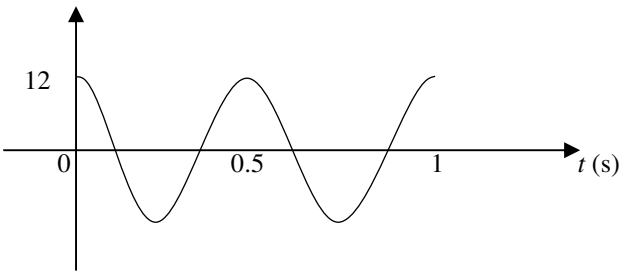
Q9 The picture of the wave in Q3 was taken at $t = 0$ s. Draw a graph of particle displacement vs distance from the origin for the wave at $t = 0.125$ s.



Q10 The picture of the wave in Q4 was taken at $t = 0$ s. Draw a graph of particle displacement vs distance from the origin for the wave at $t = 0.625$ s.



Q11 The picture of the wave in Q3 was taken at $t = 0$ s. Draw a graph of displacement of particle P vs time from $t = 0$ to $t = 1$ s.



Q12 The picture of the wave in Q4 was taken at $t = 0$ s. Draw a graph of displacement of loop Q vs time from $t = 0$ to $t = 2.5$ s.