2.4 Further questions D

ALL Questions Please

Wave motion

(1) Figure 1 shows, at one instant of time, the shape of a stretched string along which a transverse wave is travelling with wavelength 50 mm and amplitude 10 mm. Five points on the string are labelled V, W, X, Y and Z.

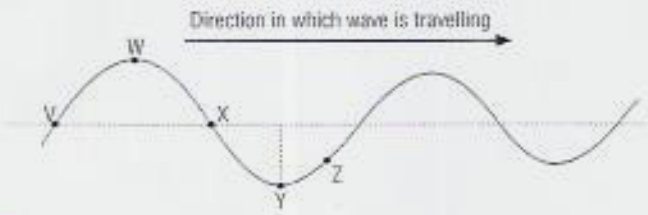

Figure 1

(a) Copy the diagram.

(i) Label on it the wavelength and amplitude.

(ii) Add a sketch of the shape of the string after it has moved 12.5 mm.

(iii) Draw arrows to show the direction in which the particles of the string at W and Y have moved.

(b) Which of the labelled points on the string are moving **(i)** π out of phase; **(ii)** $\pi/2$ out of phase; and **(iii)** $\pi/4$ out of phase with each other?

(c) The wave is travelling along the string at 0.5 m s^{-1}.

(i) How many wavelengths pass point X in one second?

(ii) What is the frequency of the wave?

(2) Figure 2 shows part of a transverse progressive wave moving from left to right at a particular time. Axes have been included.

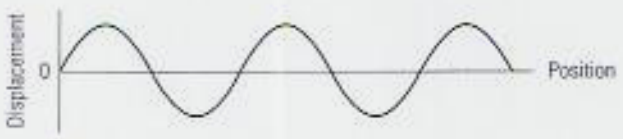

Figure 2

Sketch the figure three times, labelling the new sketches **(i)**, **(ii)** and **(iii)**.

Add a wave of the same amplitude and same speed of propagation but twice the frequency to **(i)**; same frequency but twice the speed of propagation to **(ii)**; same frequency and speed but with a phase difference of $\pi/2$ behind the original wave to **(iii)**.

(3) A wave pulse of the shape shown in Figure 3 is travelling along a string at a speed of 2.0 m s^{-1} towards X.

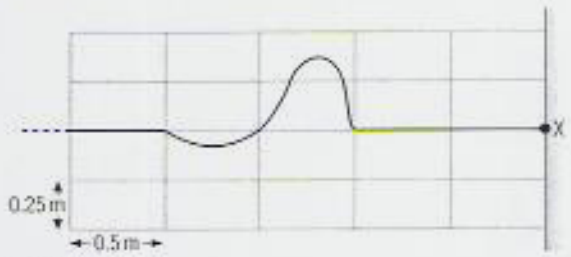

Figure 3

The leading edge is at a distance of 1.0 m from X, where the string is fixed to a rigid wall. The diagram shows the pulse at time $t = 0$. Draw a graph of the displacement of a point on the string at a distance of 0.50 m from the wall over a period from $t = 0$ to $t = 0.75$ s. Mark the scales on both axes clearly.

Wave intensity

(4) The intensity of the quietest sound that can be heard is 10^{-12} W m^{-2}. Estimate the greatest distance at which, theoretically, you might just hear the broadcast from a 10 W speaker. Assume that the speaker is acting as a point source emitting energy equally in all directions. Remember that the surface area of a sphere of radius r is $4\pi r^2$. Suggest reasons why this distance is unlikely in practice.

(5) The minimum energy of visible light of wavelength 500 to 600 nm that can just be detected by the eye is 10^{-17} W. Assume that only 1% of the power input to a 60 W light bulb is emitted between these wavelengths. Estimate the maximum distance that it might be possible to see the lit bulb. The pupil of the eye will be at its maximum diameter, say 8 mm. At its maximum sensitivity the eye only detects 8% of the light incident on it.