Suggested Solutions

Tutorial 10D Stationary Waves

Self-Practice Questions on Stationary Waves

S1

This question involves qualitative comparisons between **stationary** waves and **progressive** waves.

See Page 48 for more information.

Option A is wrong as some travelling waves needs a medium.
Option B is wrong as separation between a node and adjacent antinode for stationary wave is one quarter of a wavelength.
Option D is wrong as energy at nodes for a stationary wave does not change from kinetic to potential since particles at the nodes do not move. For travelling waves, energy at a point may at times be potential, and not just kinetic.
Option E is wrong as energy for a travelling wave is transported at a speed given by frequency multiplied by the wavelength.

Ans: (C)

S2

This question involves quantitative calculation by **inferring the wavelength** of **a standing wave**.

There are 3 full waveforms or wavelengths within 1.50m, hence

Wavelength of wave produced by vibrator,

$$\lambda = \frac{1.50}{3} = 0.50\ m$$

And thus

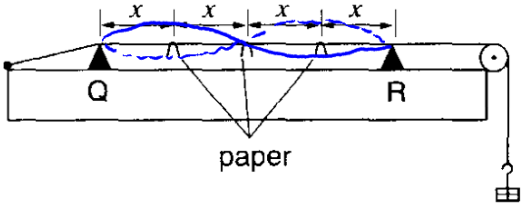
$$v = f\lambda = 20(0.50) = 10.0\ m\ s^{-1}$$

Ans: (B)

S3

This question requires an appreciation of the meaning of a **displacement node**.

Based on observation provided, the middle of the wire is a node.



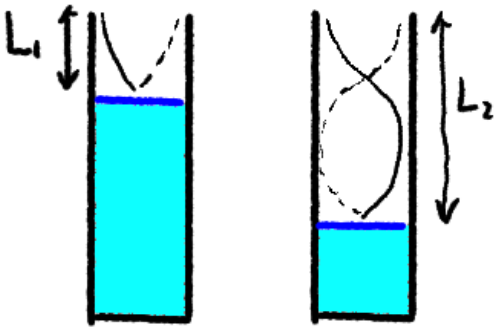
Thus wavelength of the vibration produced on the wire is 4x.

Ans: (C)

S4

This question involves calculations for **length of air column** for **resonance in an air column**.

The tuning fork is an external driver and can only produce a fixed frequency of 512 Hz.



Wavelength of sound,
$\lambda = v / f = 330 / 512 = 0.645$ m

a) The first resonance is at
$L_1 = \frac{1}{4} \lambda = 0.161$ m

b) The second resonance is at
$L_2 = \frac{3}{4} \lambda = 0.484$ m

Problem-Solving Strategy:

1. Most questions involving resonance in an air column will need you to find the wavelength of the wave, which you can obtain if given the speed, and the frequency.

2. Sketching a displacement – distance diagram of the air molecules like this would help you immensely in the next part when you are required to relate the length of the air column to the wavelength of the wave. Note the boundary conditions are nodes at the surface of water similar to the closed end of a pipe and antinodes at the cylinder's open end.

S5

This question requires a **qualitative** understanding of **pressure and displacement nodes and antinodes** at **open and closed ends** of a pipe.

At a closed end
- Displacement node (Δx zero)
- Pressure antinode (Δp maximum)

At an open end
- Displacement antinode (Δx maximum)
- Pressure node (Δp zero)

See page 58 of your Lecture Notes on how pressure varies in a stationary sound wave.

Ans: (B)