Q- A 1.5m long string is stretched between two supports with a tension such that the speed of the transverse wave on the string is 48 m/s. The string is made to vibrate. Find the wavelength and frequency of

(a) Fundamental note, and

(b) The fourth harmonic.

(a)

As the two ends of the rope is stretched between the two supports, the nodes are formed at the ends and hence in fundamental mode of vibration the length of the rope will be half of the wavelength gives

$\lambda/2 = 1.5$ m

And $\lambda = 3.0$ m

Hence the frequency of the wave in the fundamental mode (first harmonic) will be

$n_1 = c/\lambda = 48/3 = 16$ Hz.

Hence the wavelength of the wave in fundamental mode is **3.0 m** and the frequency is **16 Hz**.

(b)

In the fourth harmonic the string will vibrate with four loops and hence the length of the rope is equal to the four half wavelengths, thus we get

$4(\lambda_4/2) = 1.5$ m

Gives $\lambda_4 = 0.75$ m

As the wave velocity is property of the rope and the tension in it will remain the same and hence frequency of the fourth harmonic is given by

$n_4 = c/\lambda_4 = 48/0.75 = 64$ Hz.

Hence for the fourth harmonic the wavelength is **0.75 m** and the frequency is **64 Hz**

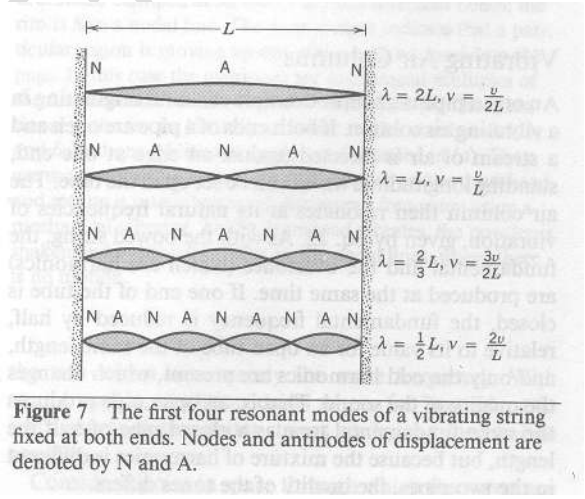

Figure 7 The first four resonant modes of a vibrating string fixed at both ends. Nodes and antinodes of displacement are denoted by N and A.

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