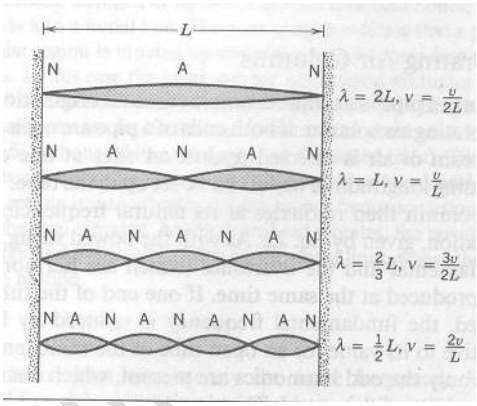
Q- A 1.5 m long rope is stretched between two supports with a tension that makes the speed of transverse waves on the rope 48 m/s. The rope is made to vibrate, what will be the wavelength an frequency of (a) the fundamental and (b) the fourth harmonic?

(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.

(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.