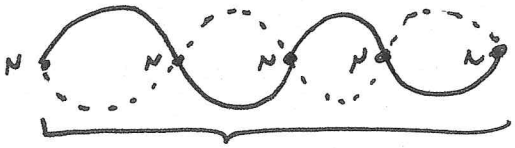
Standing Waves – Example Problems

Name: TEACHER Date: 2013

1. A guitar string is 50 cm long and is vibrating at a frequency of 550 Hz. The string is vibrating at the 4th harmonic. Calculate the speed of the wave.



$L_4 = \frac{(4)\lambda}{2}$

$L_4 = 2\lambda$

$2\lambda = 0.50\text{m}$

$\lambda = \frac{0.50\text{m}}{2}$

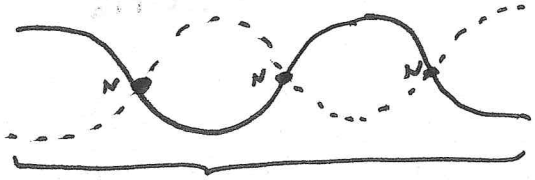
$\lambda = 0.25\text{m}$

$v = f\lambda$

$= (550)(0.25)$

$v = 137.5\text{m/s}$

2. An open air column (at both ends) is vibrating at the third resonance length. The column is 25 cm long and the air temperature is 15°C. Calculate the frequency of the sound.



$L_3 = \frac{(3)\lambda}{2}$

$L_3 = \frac{3\lambda}{2}$

$\frac{3\lambda}{2} = 0.25\text{m}$

$3\lambda = 0.50$

$\lambda = 0.167\text{m}$

$v_s = 332 + 0.6(15)$

$v_s = 341\text{m/s}$

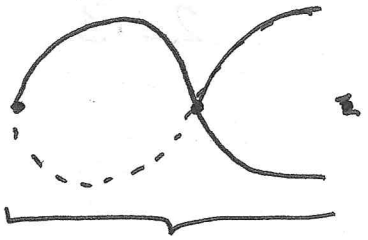
$v = f\lambda$

$\frac{v}{\lambda} = f$

$\frac{(341)}{(0.167)} = f$

$\therefore f = 2042\text{ Hz}$

3. A metal rod, fixed at one end, is vibrating at the 2nd harmonic and has a measured wavelength of 20 cm. a) Calculate the length of the rod b) Calculate the speed of the wave if the rod is vibrating 320 times every 4 seconds.



$L_2 = \frac{(2(2)-1)\lambda}{4}$

$L_2 = \frac{3\lambda}{4}$

$\frac{3\lambda}{4} = L_2$

a) since $\lambda = 0.20\,m$

$L_2 = \frac{3(0.2)}{4}$

$\boxed{L_2 = 0.15\,m}$

The rod is 15 cm long.

b) $V = f\lambda$

$= (80)(0.2)$

$\boxed{V = 16\,m/s}$

$f = \frac{320}{4}$

$f = 80\,Hz$