$v = f\lambda$

# Standing Waves Worksheet

For each problem show a diagram of the standing waves, and show all work in finding the solution.

1. A string, fixed at both ends, is 50.0 cm long. What are the first three natural frequencies that can be produced by the spring? $v = 325\ m/s$

2. A standing wave with a wavelength of 2.3 m is produced on a string fixed at both ends. How far from the end are the first 2 antinodes?

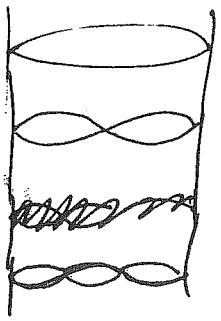
3. a) What are the wavelengths of the 4 longest waves that can produce standing waves on a string of length 30.0 cm, fixed at both ends?
   b) If the speed of the waves in the spring is 225 m/s, what are the frequencies that correspond with the wavelengths found in (a)?

4. What is the fundamental frequency sounded by a guitar string 55 cm long if the speed of sound in the string is 195 m/s?

5. A rope is fastened at one end and the other end is shaken with a frequency of 10.0 Hz. If the speed of the standing wave in the rope is 25.0 m/s, how far away from the attached end are:
   a) the nearest antinode  b) the nearest node

6. The distance between adjacent nodes in a stretched string is 35.0 cm.
   a) If the frequency of vibration is 350.0 Hz, calculate the speed of the wave.
   b) If the frequency is reduced to 150.0 Hz, what is the new wavelength?

1.



$L = \frac{1}{2}\lambda$

$L = \lambda$

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

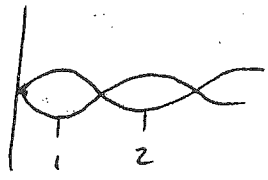
$f = \frac{v}{\lambda}$

$f_1 = \frac{325}{2(0.5)} = 325\ Hz$

$f_2 = \frac{325}{0.5} = 650\ Hz$

$f_3 = \frac{325}{\frac{2(0.5)}{3}} = 975\ Hz$

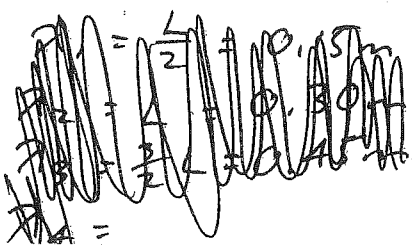
2.




① $d = \frac{1}{4}\lambda = 0.58\ m$

② $d = \frac{3}{4}\lambda = 1.7\ m$

3. (a)



$\lambda_1 = 2L = 60\ cm$

$\lambda_2 = L = 30\ cm$

$\lambda_3 = \frac{2}{3}L = 20\ cm$

$\lambda_4 = \frac{L}{2} = 15\ cm$

(b) $f = \frac{v}{\lambda}$

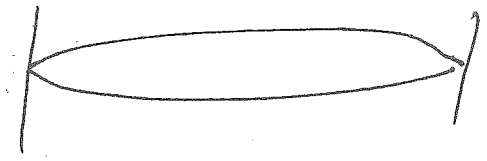
$f_1 = 375\ Hz$

$f_2 = 750\ Hz$

$f_3 = 1125\ Hz$

$f_4 = 1500\ Hz$

4.



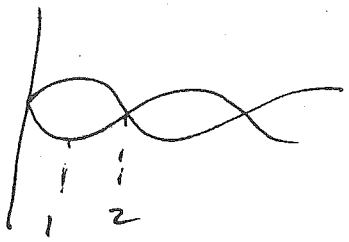
$\lambda = 2L = 1.10\,m$

$v = f\lambda$

$f = \frac{v}{\lambda} = \frac{195}{1.1}$

$\boxed{f = 1.8 \times 10^2\,Hz}$

5.

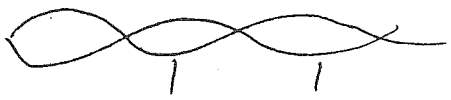



$d_1 = \frac{1}{4}\lambda = \boxed{0.63\,m}$

$d_2 = \frac{1}{2}\lambda = \boxed{1.3\,m}$

$\lambda = \frac{v}{f} = \frac{25}{10} = 2.5\,m$

6.




$\lambda = 70\,cm$

(a) $v = f\lambda = (350)(0.7) = \boxed{245\,m/s}$

(b) $\lambda = \frac{v}{f} = \frac{245}{150} = \boxed{1.63\,m}$

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