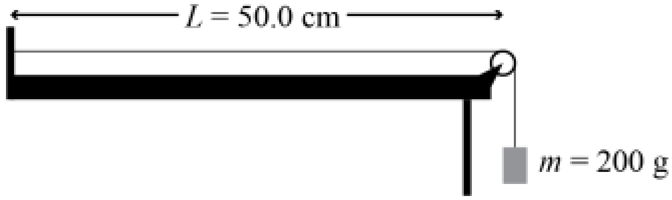
Worksheet 9-5 Waves on Strings

1. A string is fixed between the wave driver and pulley located 50.0 cm apart. A 200. g mass is attached to the end of the string providing the tension. When a wave generator vibrates at 150. Hz the string resonates in the third mode.



   a. Sketch the first five modes of vibration for this setup.
   b. Find the wavelength for each of these modes.
   c. Determine the speed of the wave for each of these modes.
   d. Determine the frequency for each of these modes.

Number of Antinodes	Diagram	Wavelength	Frequency	Wave Speed
1				
2				
3				
4				
5				

2. The same string is later found to have a wave speed of 100.0 m/s.
   a. What could have caused this to happen?

   b. Complete the chart for the first four modes of vibration when the wave speed is 100. m/s.

Number of Antinodes	Diagram	Wavelength	Frequency	Wave Speed
1				
2				
3				
4				

3. Eric Clapton plucks a string on his guitar which causes the string to vibrate with a standing wave that has four nodes and has a frequency of 440 Hz. The wave travels down the string at 176 m/s.
   a. How long is a wave on the string? Draw a diagram of the standing wave.

   b. How long is the vibrating string?

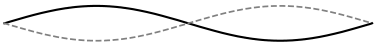
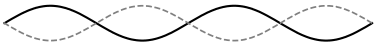
4. Describe some factors that a guitar player can use to vary the frequency (pitch) of the sound produced by a guitar. Describe the change that each one would produce in the pitch of the sound. (Hint: you should be able to identify four changes that affect the pitch.)

1.

Number of Antinodes	Diagram	Wavelength	Frequency	Wave Speed
1		1.00 m	50.0 Hz	50.0 m/s
2		0.500 m	100. Hz	50.0 m/s
3		0.333 m	150. Hz	50.0 m/s
4		0.250 m	200. Hz	50.0 m/s
5		0.200 m	250. Hz	50.0 m/s

2a. The most likely reason for an increase in speed is an increase in tension.

2b.

Number of Antinodes	Diagram	Wavelength	Frequency	Wave Speed
1		1.00 m	100. Hz	100. m/s
2		0.500 m	200. Hz	100. m/s
3		0.333 m	300. Hz	100. m/s
4		0.250 m	400. Hz	100. m/s

3a. 

$$v = f\lambda$$
$$\lambda = \frac{v}{f}$$
$$\lambda = \frac{176\ \text{m/s}}{440\ \text{Hz}}$$
$$\lambda = \boxed{0.40\ \text{m}}$$

3b. $L = \boxed{0.60\ \text{m}}$

4. Change the length of the string, the tension of the string, the mass of the string, or create a node at a point other than the ends of the string.