Week 6

Detailed learning goals

By completing this topic, you should be able to:

- Define and explain waves.
- Explain waves moving through a medium
- Explain what transverse and longitudinal waves are and how they differ
- Explain how wave speed is dependent on the wave medium
- Calculate and understand the linear density of a medium
- Calculate the velocity of a wave on a string
- Explain the difference between a snapshot and a history graph
- Define the wave terms amplitude, wavelength, frequency and period
- Explain the fundamental relationship for sinusoidal waves
- Define and understand the principle of superposition
- Explain constructive and destructive interference
- Explain and predict interference with waves on a string
- Define standing waves.
- Explain the relationship between superposition and standing waves
- Explain the movement of a reflected wave
- Calculate the frequency and wavelength of standing waves
- Explain and calculate the fundamental wave and higher harmonics.

Prescribed readings for SLE123 content

Please read the following sections from Giambattista Physics (5th ed.). New York: McGraw-Hill:

- Section 11.1 Waves and Energy Transport.
- Section 11.2 Transverse and Longitudinal Waves.
- Section 11.3 Speed of Transverse Waves on a String.
- Section 11.4 Periodic Waves.
- Section 11.5 Mathematical Description of a Wave.
- Section 11.6 Graphing Waves.
- Section 11.7 Principle of Superposition.
- Section 11.10 Standing Waves.

8.4 A transverse wave propagates in the negative x-direction with a frequency of 20 Hz and a propagation velocity of $25 ms^{-1}$. What are the wavelength and period of this wave?
Answer: wavelength = 1.25m and T = 0.05 s

8.6 A boat is bobbing up and down on the water as waves pass underneath it. The depth of the water under the boat oscillates between 3m and 4 m. The boat is stationary with respect to the shore and it is 2.9 s between the crests of successive waves. A person on shore sees the crests of the wave passing by at $2 ms^{-1}$. What is the distance between crests of this wave?
Answer: wavelength= 5.8m

More problems:

1. A sinusoidal wave travelling on a string has a period of 0.20 s, a wavelength of 32 cm, and an amplitude of 3 cm. What is the speed of this wave?

2. A sinusoidal wave has period 0.33 s and wavelength 4.5 m. What is the wave speed?

3. A sinusoidal wave travels with speed 200 m/s. Its wavelength is 4.0 m. What is its frequency?

4. . The picture below is a history graph of a wave at $x = 0$ m of a wave moving to the right at 2 m/s. What are the amplitude, frequency, and wavelength of this wave?