The Description of Waves

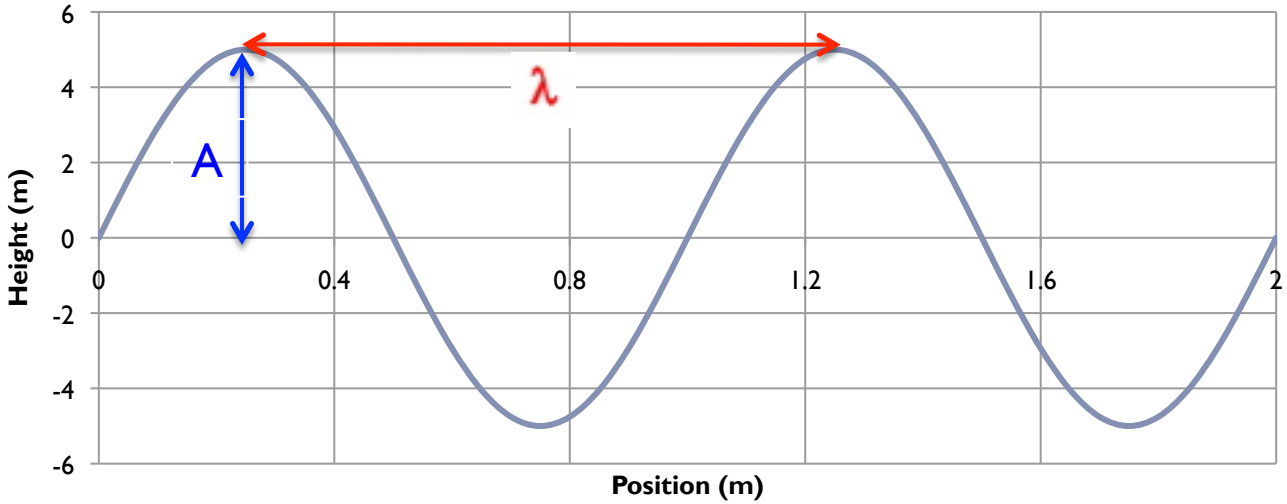
Pre-Class Questions

Problem Set (due next time)
Ch 12 - 1ab, 3, 5, 6

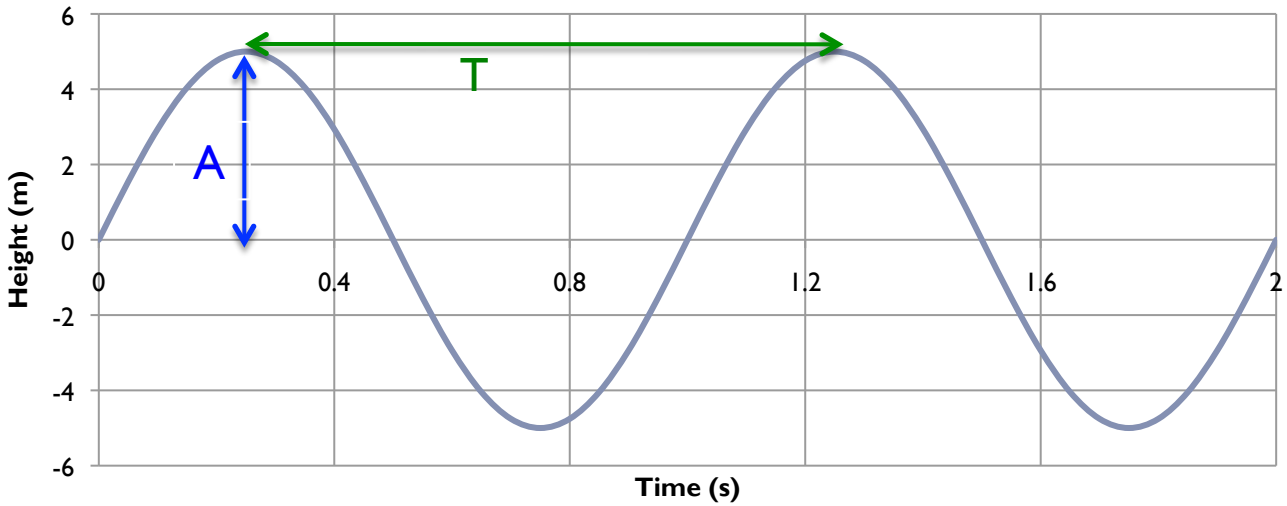
Lecture Outline

1. Properties of Waves
2. Waves on a String

A Wave at Some Specific Time (a photo)



A Wave at Some Specific Position

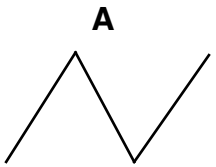


Example 1: The speed of sound is about 350m/s. Middle C on the piano has a frequency of 262Hz. Find the wavelength of the sound wave from middle C.

Shown below are six waves, which are all the same kind of wave (e.g., all seismic waves) traveling in various media. The waves all have the same frequency, but their amplitudes, A, and wavelengths, λ, vary as shown in the figures. Specific values for these properties are given in each figure.

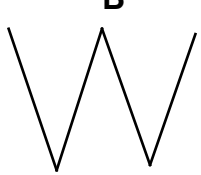
Rank these waves from greatest to least based on the speed of the waves. That is, put first the wave that is moving fastest and put last the wave that is moving slowest.

A



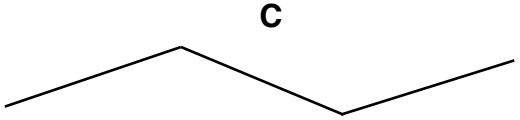
$A = 6$
$\lambda = 3$ m

B



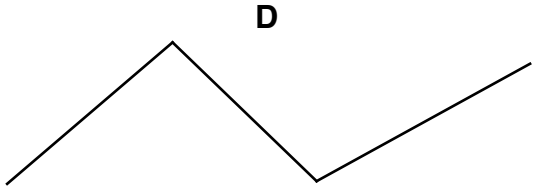
$A = 8$
$\lambda = 2$ m

C



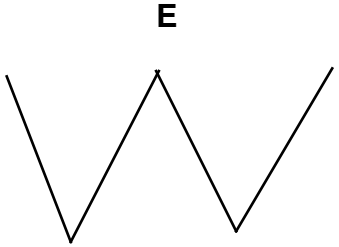
$A = 4$
$\lambda = 6$ m

D



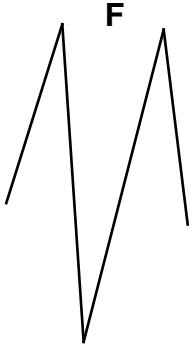
$A = 6$
$\lambda = 6$ m

E



$A = 8$
$\lambda = 3$ m

F



$A = 16$
$\lambda = 2$ m

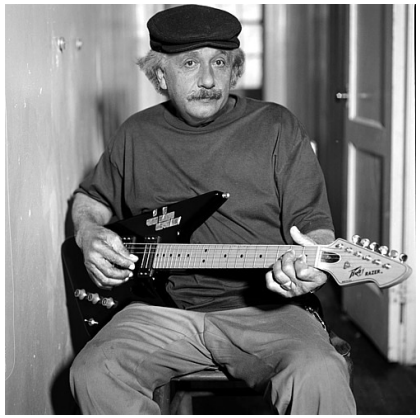
Fastest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Slowest

Or, all of these waves travel at the same speed. ____

Or, all of these waves are at rest. ____

Please carefully explain your reasoning.

Guitar Man?



1. Guitar makers design their instruments so that the tension in all the strings is about the same. Explain.

2. The top string on a guitar is usually tuned to and E-note. The bottom string is also tuned to an E but two octaves lower. Since each octave is a factor of two, express the ratio of their frequencies.

$$\frac{f_{top}}{f_{bottom}} =$$

3. Given the wavelengths of the two strings are the same, find the ratio of the wave speeds. Explain your reasoning.

$$\frac{v_{top}}{v_{bottom}} =$$

4. Given the tension in the two strings is the same, find the ratio of the mass per unit length. Explain your reasoning.

$$\frac{\mu_{top}}{\mu_{bottom}} =$$

5. Explain why you can't replace a broken top string with a spare bottom string.

Example 2: A certain violin string is 33cm long, it has a tension of 52N, and is plays at a frequency of 660Hz. The wavelength is twice the length. Find the mass of the string.

Lecture 30 - Summary

Amplitude is the height of the wave.
Wavelength is the distance for a wave to complete a full cycle.
Frequency is the number of cycles completed per unit of time.

The velocity is related to the frequency and wavelength $v = \lambda f$.

The velocity doesn't depend upon frequency or wavelength (usually).

Velocity depends upon properties of the medium.

For s string $v = \sqrt{\frac{F_T}{\mu}}$ where $\mu = \frac{m}{\ell}$.