

Autumn Term, Week 8 Tutorial  
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Read the following sections of University Physics and lectures.

Wavefunctions  
Wave Speed  
Transverse Waves  
Longitudinal Waves  
Wave Equation

. A steel piano wire is 0.7 m long and has a mass of 5 g. It is stretched with a tension of 500 N. What is the speed of transverse waves on the wire? To reduce the wave speed by a factor of 2 without changing the tension, what mass of copper wire would have to be wrapped around the wire?

. An elastic string has mass 1 g and natural length 0.1 m. A mass of 1 kg is attached to its lower end, and the string is stretched by 0.02 m. Calculate the speed of propagation of transverse waves along the string.

If the mass is set into small vertical oscillations, it oscillates with period  $T$ . A transverse ripple is now excited and travels along the string, and is reflected at both ends. How many times will this ripple pass a point on the string in the time  $T$ ?

(You may assume the tension in the string is uniform.)

Guitarists usually press strings firmly down over a fret with their fingers. However, it is possible to obtain different notes by just touching a string above certain frets (and serious violinists exploit this). One octave is a factor of two in pitch (or frequency); there are 12 notes in an octave and each note is separated from the one above it by the same factor in pitch. Explain why touching the string above the fret at  $\sim 67\%$  gives a note one octave higher than that obtained when holding the string firmly against this fret. What are the corresponding ratios of pitch expected for the two fingerings for each of the frets at: near 80%, near 76%, and near 40%?

