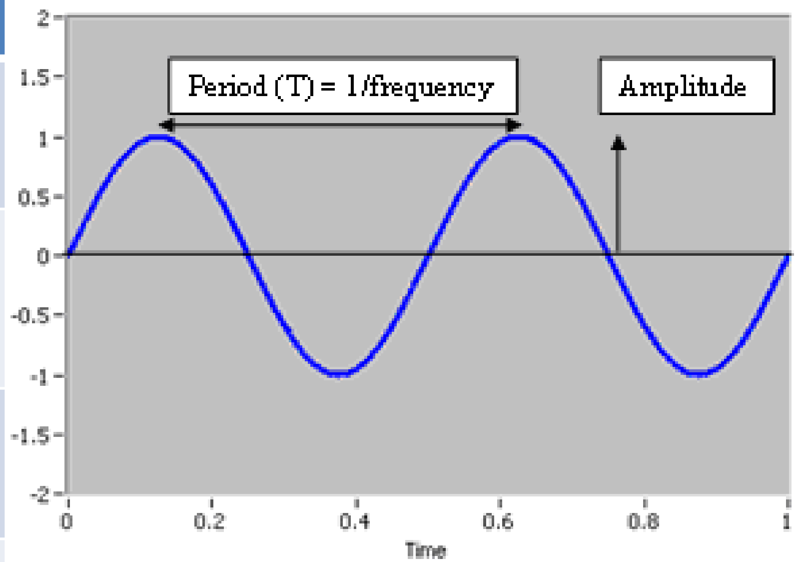
Oscillations

$$x(t) = A\sin(\varpi t + \varphi_0) = A\sin\left(\frac{2\pi}{T}t + \varphi_0\right)$$

Parameter	Formula	Units
Period	T	s
Frequency	f=1/T	1/s=Hz (Hertz)
Angular frequency	$\omega=2\pi f=2\pi/T$	1/s
Amplitude	A	varies

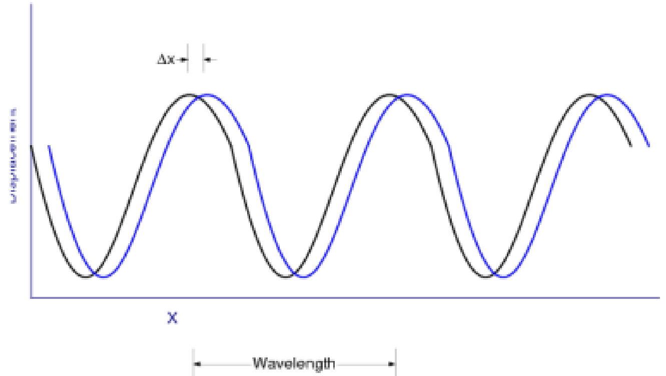


Travelling wave

$$x(t) = A\sin(\varpi t - kx) = A\sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right)$$

This wave moves to the positive direction of ***x*** with speed ***s***:

$$s = \frac{\lambda}{T} = \lambda f = \frac{\varpi}{k}$$



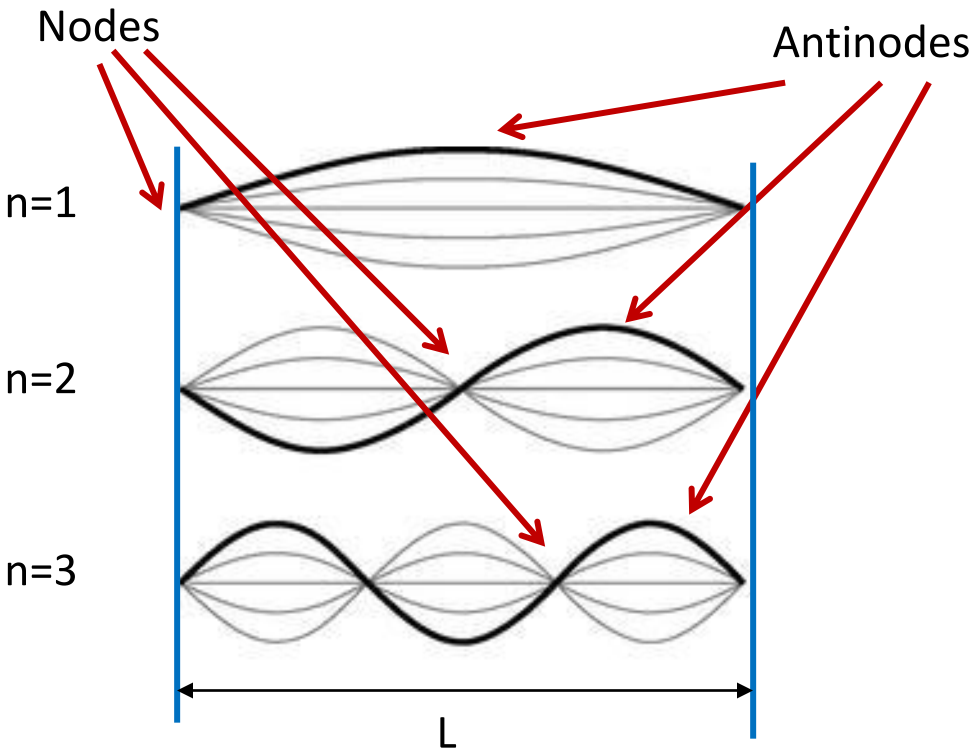
Oscillations	Wave
Period [s]: T	Wavelength[m]: λ
Angular frequency [1/s]: $\omega=2\pi/T$	Wave Number [1/m]: $k=2\pi/\lambda$

Standing waves

$$A\sin(\varpi t - kx) + A\sin(\varpi t + kx) = 2A\sin(kx)\cos(\varpi t)$$

Wave moving in '+' direction + Wave moving in '-' direction = Standing Wave

$$\lambda = \frac{Ln}{2}, \qquad n = 1,2,3\ldots$$



Homework

Problem 1.

Use the dimensional analysis (method of units) to find the speed of a wave propagating along a stretched string. Note that it is not the speed of sound in the material of the string. The speed you need to find depends on the tension force F, mass of the string M, and its length L.

Problem 2.

The first string of a guitar is supposed to be tuned to frequency 330Hz (note E). Its length is 80 cm. Find the speed of the wave propagation on the perfectly tuned string. Using the result of Problem 1, determine the tension force F at which this string will be tuned. The mass of the vibrating part of the open E string is 0.3 g.