Waves and Sound

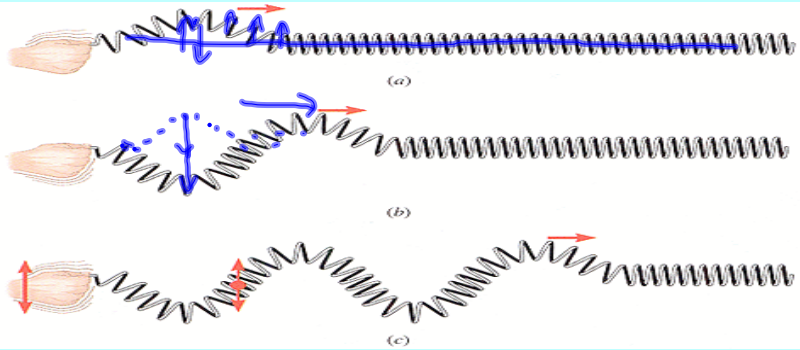
1. Waves
2. Sound
3. Music

What is a wave?

All waves... -transfer energy from one point to another
-result from oscillations at its source

Most waves... -travel through a medium → repetitive, periodic → substance in which something travels

Along a wave, there is always a periodic oscillation of particles (or energy in the case of light). The particles move back and forth around its equilibrium point (much like a pendulum).



There are many examples of waves...

Waves are often divided into 2 categories:

Transverse wave: The oscillation of the particles is perpendicular to the direction of motion of the wave.

→ vibration

http://www.acs.psu.edu/drussell/Demos/waves-intro/waves-intro.html

water wave
Slinky

Longitudinal wave: The oscillation of the particles is parallel to the direction of motion of the wave

- sound

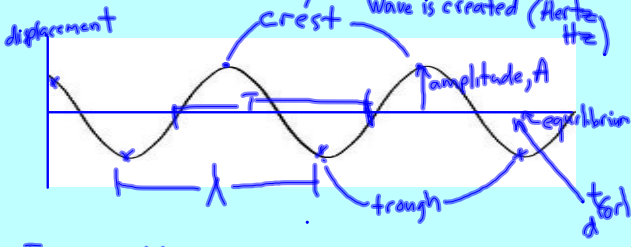
seismic

Wave Characteristics and Terms

Wavelength, $\lambda \rightarrow$ m

Period $\rightarrow$ time it takes for one cycle, T $\rightarrow$ s

frequency, f $\rightarrow$ cycles/s $\rightarrow$ rate at which the wave is created (Hertz, Hz)



In all cases $f = \frac{1}{T}$ or $T = \frac{1}{f}$

What is f and T for a car engine operating at 3000 rpm?

f = 3000 rev. per min

$\downarrow \div 60$

= 50 Hz

$T = \frac{1}{f} = \frac{1}{50} = 0.02$ s

The Wave Equation

We know that v = $\frac{d}{t}$

For 1 cycle of a wave, the wave travels a distance, d = λ

in a time of t = T

So then v = $\frac{\lambda}{T} = \lambda\left(\frac{1}{T}\right)$ But also $f = \frac{1}{T}$

So v = λf

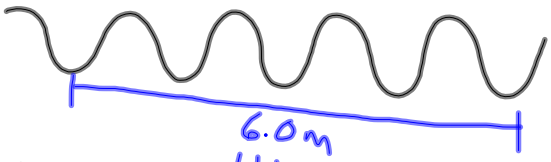
This is known as the wave equation.

mHz

$m(s^{-1})$

Example:

A wave has 5 troughs spread out over 6.0 m. It takes 16 s for a point on the wave to go up and down 4 times. Determine the speed of the wave.



4λ

$4\lambda = 6.0\ m$

$\lambda = 1.5\ m$

$f = \frac{4}{16}\left(\frac{N}{t}\right)$

$= 0.25\ Hz$

$v = f\lambda$

$= (0.25)(1.5)$

$= 0.375\ \frac{m}{s}$

$\lambda = \frac{d}{N}$ $f = \frac{N}{t}$ $v = f\lambda$

$= \frac{d}{N} \cdot \frac{N}{t} = \frac{d}{t}$