Frequency, Period, Wavelength, Speed

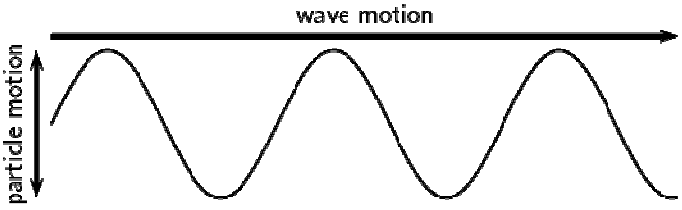
September 5, 2015 7:49 AM

What is a wave?

A transfer of energy through a medium.

Type 1: Transverse Waves

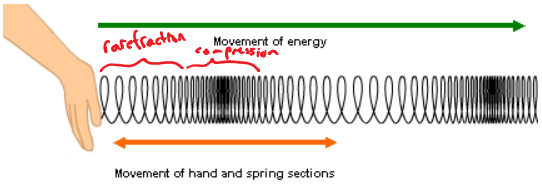
Particles in the medium move perpendicularly to the direction of the waves motion.



Examples: Light / Radio waves

Type 2: Longitudinal Waves

Particles in a medium vibrate parallel to the direction of the waves motion



Example: Sound Waves

Type 3: Surface Waves

A mixture of both transverse and longitudinal waves

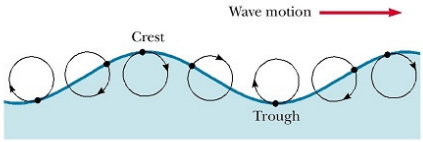
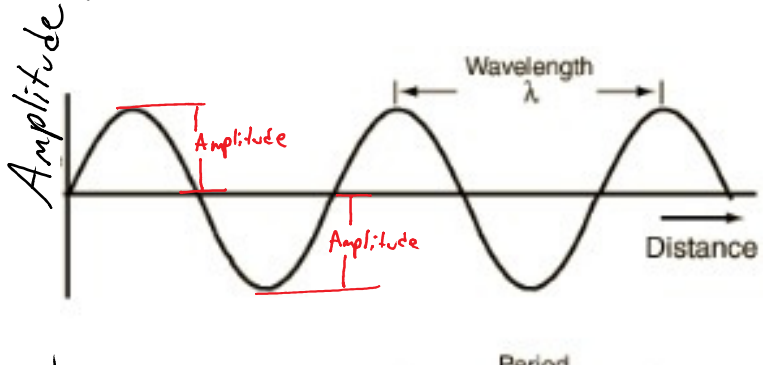
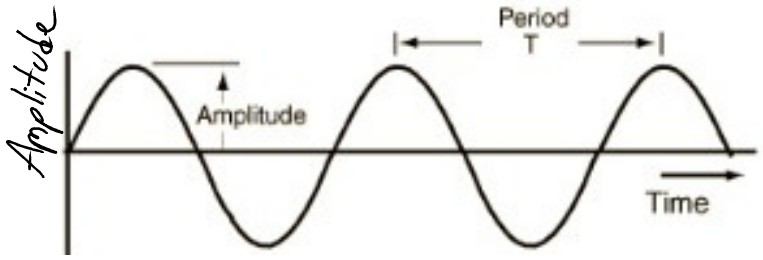


Figure 16.5 The motion of water molecules on the surface of deep water in which a wave is propagating is a combination of transverse and longitudinal displacements, with the result that molecules at the surface move in nearly circular paths. Each molecule is displaced both horizontally and vertically from its equilibrium position.

Example: Ocean Waves

Properties of a Wave





Wavelength: The **distance** between two repeating points

Symbol: λ

Units : m (meters)

Period: The **time** between two repeating points

Symbol: T or one complete cycle

Units : seconds

How long for one wave to pass.

Frequency: The number of waves in one second

Symbol: f

Units: Hz (Hertz)

How many waves pass in one second

Amplitude: The maximum displacement of the wave from it's rest position

Symbol: A

Units : meters

Velocity of a wave: How fast a wave is moving.

Symbol: v

Units : m/s

$$v = \frac{\lambda}{T} \quad \text{or} \quad v = \lambda f \quad \star \quad f = \frac{1}{T}$$

$T = \frac{\text{time}}{\text{cycles}}$

$f = \frac{\text{cycles}}{\text{time}}$

Ex: A clock 515m away chimes and is heard 1.5seconds later.

a) What is the velocity of the sound wave in the air?

$v = \frac{d}{t} = \frac{515}{1.5} = 343 \text{ m/s}$

b) What is the period of this wave if it's frequency is 436Hz?

$T = \frac{1}{f} = \frac{1}{436} = 0.00229 \text{ sec}$

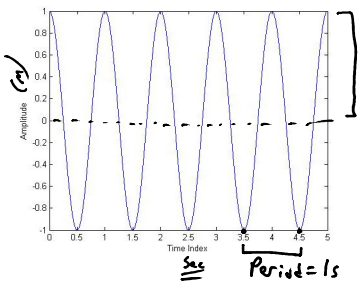
c) What is the wavelength of the wave?

$v = \frac{\lambda}{T}$ or $\frac{v}{f} = \frac{\lambda f}{f}$

$\lambda = \frac{343}{436}$

$\lambda = 0.787 \text{m}$

Find amplitude, Wavelength, Velocity, Frequency, Period of following waves



Amplitude = 1m

$f = \frac{1}{T} = \frac{1}{1} = 1Hz$

Frequency = 1Hz

Period = 1s

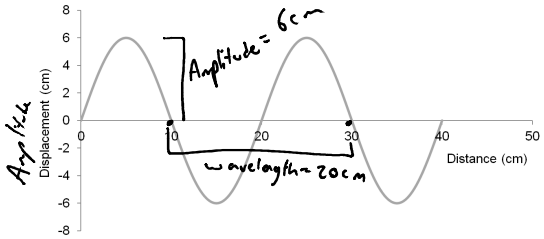
Assume the wave above travelled 40m in the 5 seconds represented above.

$v = \frac{d}{t} = \frac{40}{5} = 8 m/s$

$v = \lambda f$

$8 = \lambda \cdot 1$

$8m = \lambda$



Assume the wave above took 5 seconds to travel the 40cm represented above.

$v = \frac{d}{t} = \frac{0.4}{5} = 0.08 m/s$

$v = \lambda f$

$\frac{0.08}{0.2} = \frac{0.2 f}{0.2}$

$f = 0.4 Hz$

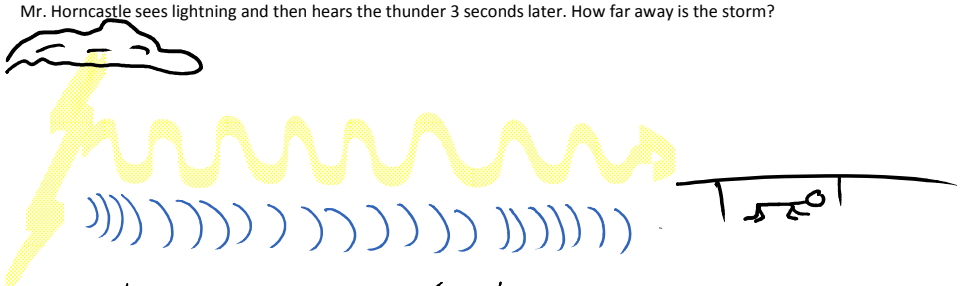
$T = \frac{1}{f} = \frac{1}{0.4}$

$T = 2.5 sec$

Speed of Sound = 343 m/s

Speed of Lightning = 3.00×10^8 m/s = c

Mr. Horncastle sees lightning and then hears the thunder 3 seconds later. How far away is the storm?



Light

$d = c\, t_1$

$d = c(t_2 - 3)$

Sound

$d = v_s \cdot t_2$

$d = v_s \cdot t_2$

$d = v \cdot t$

$t_1 = t_2 - 3$

$d = c\,t_1$ $\qquad$ $d = v_s \cdot t_2$

$d = c(t_2 - 3)$ $\qquad$ $d = v_s \cdot t_2$

Sub in d

$v_s\,t_2 = c(t_2 - 3)$

$343\,t_2 = (3\times10^8)\,t_2 - 9\times10^8$

$9\times10^8 = 3\times10^8 t_2 - 343\,t_2$

$9\times10^8 = 2.99999657\times10^8\,t_2$

$\frac{9\times10^8}{3\times10^8} = \frac{3\times10^8\,t_2}{3\times10^8}$

$3\text{ seconds} = t_2$

$d = v \cdot t$

$t_1 = t_2 - 3$

$d = v_s \cdot t_2$

$d = (343)(3)$

$d = 1029\text{ km}$