Unit 4 - Waves

Section 1

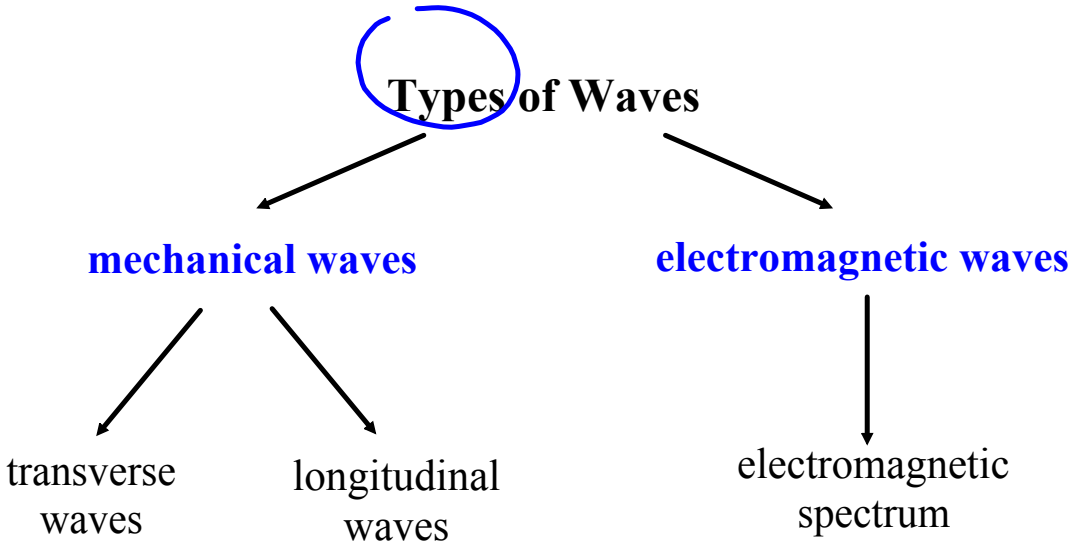
Fundamental Properties

Waves

wave

wave pulse

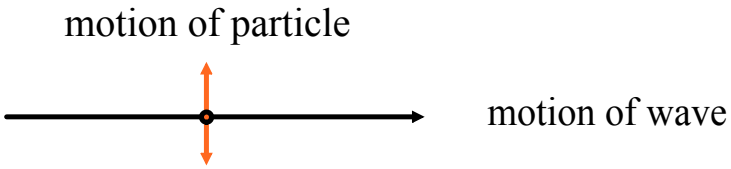
periodic wave



Mechanical Waves

Each type of mechanical wave is defined in terms of the direction of the wave's motion as compared to the direction of the medium's motion.

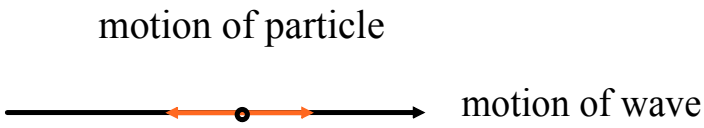
1. transverse waves



http://surendranath.tripod.com/Applets.html

http://www.animatedscience.co.uk/blog/wp-content/uploads/focus_waves/tl-wave.html

2. longitudinal waves



The speed of a mechanical wave depends on the properties of the medium.

Electromagnetic Waves

There is a spectrum of electromagnetic waves. See below.

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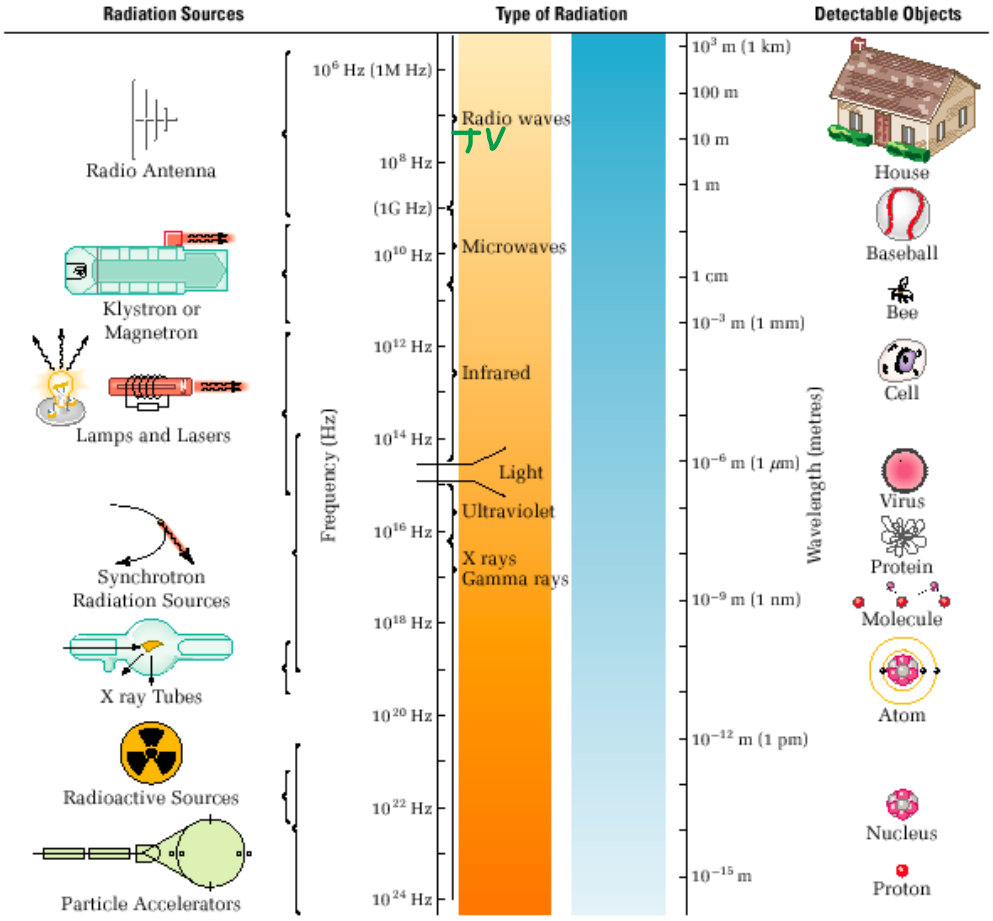
Figure 9.7 The electromagnetic spectrum includes a range of frequencies that covers more than 18 orders of magnitude. The subdivisions are artificial and, to some extent, determined by the mechanism that is used to produce them.



All electromagnetic waves travel at the speed of light in a vacuum.

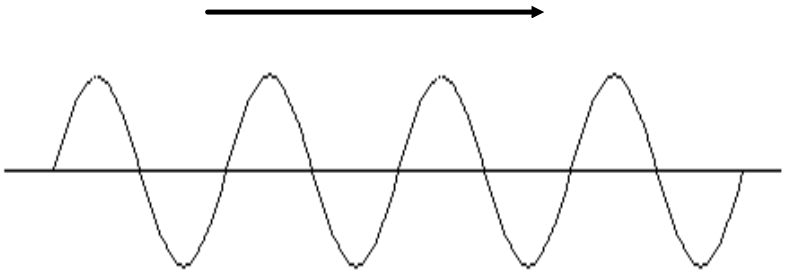
$$v = 3.00 \times 10^8 \text{ m/s}$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

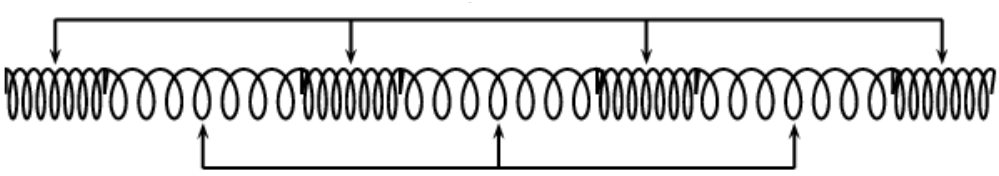
c -> speed of light in a vacuum

Handout

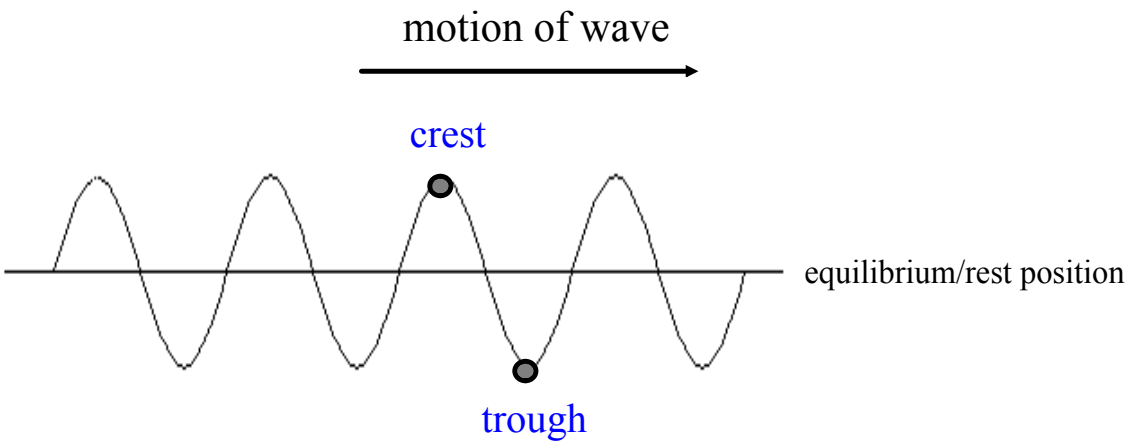
Transverse Wave



Longitudinal Wave



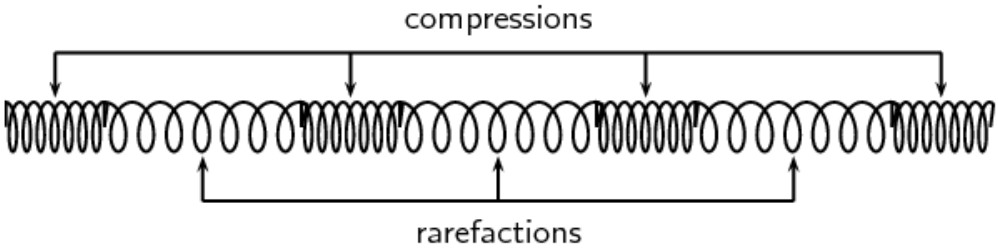
Anatomy of a Transverse Wave



Anatomy of a Longitudinal Wave

compression

rarefaction/expansion



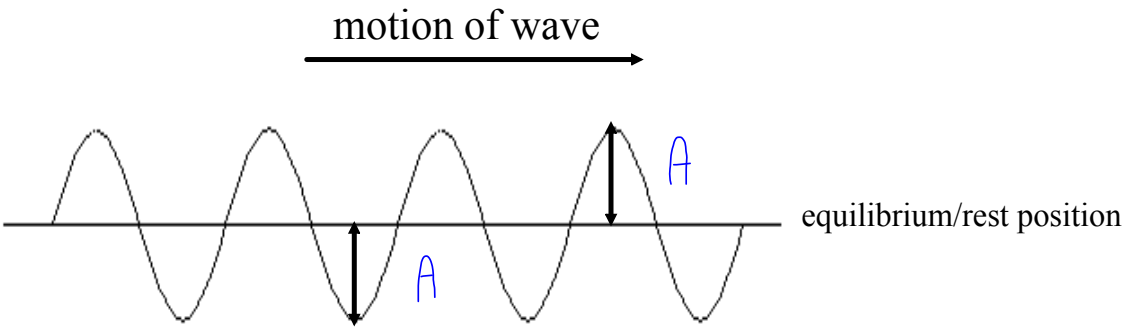
expansion

Measures of a Wave

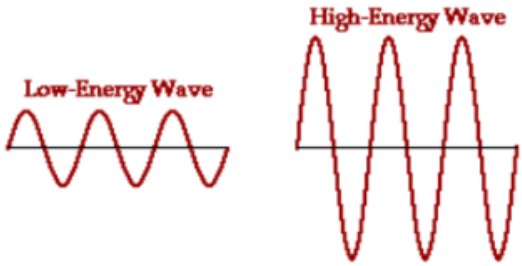
1. amplitude

symbol: A

units: cm, m, km



The amplitude of a wave is a measure of how much energy the wave is transporting.



$$E \propto A^2$$

$4E \quad (2A)^2$

$9E \quad (3A)^2$

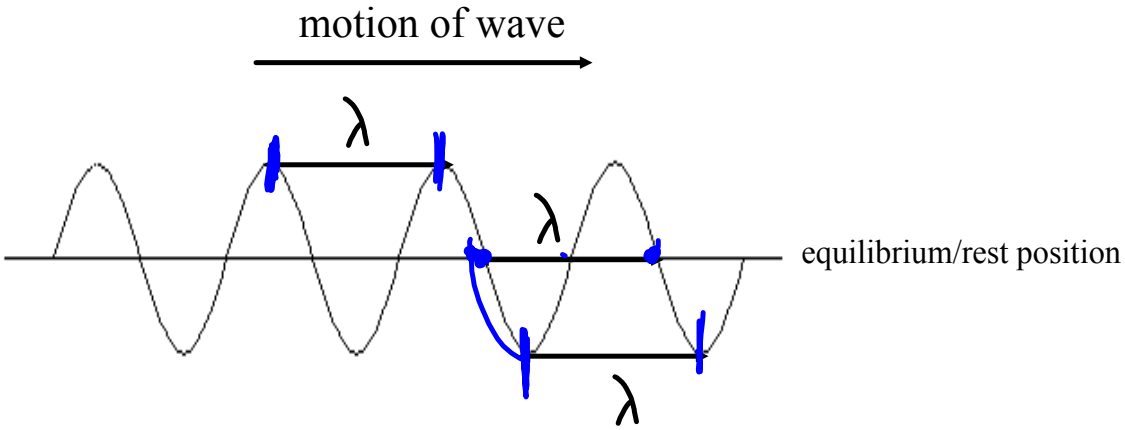
$\frac{1}{25}E \quad \left(\frac{1}{5}A\right)^2$

2. wavelength

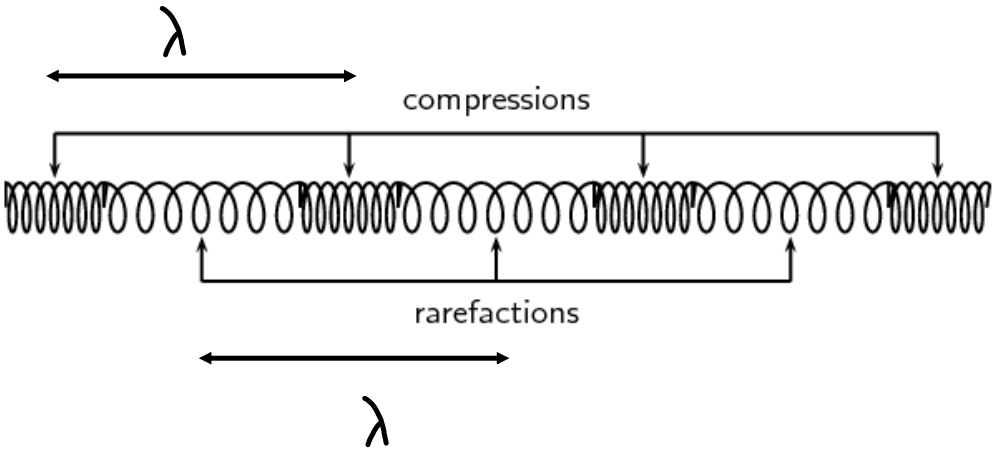
symbol: (Greek letter lambda) λ

units: cm, m, km

Transverse Wave



Longitudinal Wave



3. frequency

symbol: f

units: s^{-1}, Hz

hertz

$$f = \frac{\#\ \text{waves}}{\text{time}}$$

$\frac{\#}{s}$ s^{-1}

$4\ 1$

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

4. period

symbol: T

units: s

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

5. wave speed

symbol: v

units: m/s

$$v = \frac{d}{t}$$

distance (m)
time (s)

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

λ - wavelength (m)
T - period (s)

Universal Wave Equation

$$v = f\lambda$$

f → freq. (Hz)
λ → wavelength (m)

$$Hz \cdot m$$

$$\frac{1}{s} \cdot m$$

$$\frac{m}{s}$$

P3 DH

Physics 112

Chapter 8 – Waves Transferring Energy
Problems – Wave Equation and More

1. A 0.5 Hz wave moves along a rope with a wavelength of 40 cm. What is its speed? (0.2 m/s)

2. The distance between successive crests in a series of water waves is 5.0 m, and the crests travel 8.6 m in 5.0 s. Calculate the frequency of a block of wood bobbing up and down in the water. (0.34 Hz)

3. The wavelength of a water wave is 3.7 m and its period is 1.5 s. Calculate
   a) the speed of the wave (2.5 m/s)
   b) the time required for the wave to travel 100 m (40 s)
   c) the distance travelled by the wave in 1.00 minute (1.5×10^2 m)

4. A water wave travels 60 cm in 2.0 s. If the wavelength of the wave is 5.0 cm, what is the frequency of the wave? (6.0 Hz)

5. A boat at anchor is rocked by waves whose crests are 30 m apart and whose speed is 8.0 m/s. What is the interval of time between crests striking the boat? (3.8 s)

6. A television station broadcasts with a frequency of 90 MHz. What is the wavelength of the waves? (3.3 m)

Summary

Quantity	Symbol	Unit

Attachments

- P112 - Superposition.notebook
- P111-112 Lab Resonance.notebook