

SPH4U UNIVERSITY PHYSICS

THE WAVE NATURE OF LIGHT Properties of Waves & Light (P.440-458)

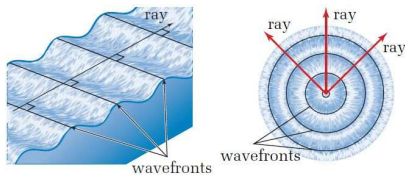
Properties of Waves & Light

If you have ever gone surfing, or watched a news report about a tsunami, you know that water waves can transmit a large amount of energy. Other examples of waves are mechanical waves, such as the wave on a vibrating string or the surface of a ringing bell, radio waves such as AM and FM waves, and seismic waves produced by earthquakes. All waves share the same basic properties.



Properties of Waves

- A **wave** is a moving disturbance that transports energy from one place to another but does not necessarily transport matter.
- The front edge of a wave is called the **wave front**.
- The **crest** of the wave is the upper half of the wave.
- The **trough** of the wave is the lower half of the wave.



Properties of Waves

- One complete crest and one complete trough represent **one cycle** of the wave.
- The **wavelength (λ)** is the distance between two successive points vibrating in phase (i.e. crest to crest, trough to trough, ...).
- The **amplitude (A)** is the maximum displacement of the wave from its rest (equilibrium) position.

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Properties of Waves

- The **period (T)** of a wave is the time required for one wave cycle to pass a particular point. The units are seconds (s).
- The **frequency (f)** is the number of wave cycles that pass a particular point per unit time. The units are hertz (Hz or 1/s).
- Frequency and period are reciprocal values (i.e. $f = 1/T$ and $T = 1/f$)
- The equation relating the speed, frequency (or period) and wavelength of a wave is the universal wave equation:

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

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Properties of Waves

PRACTICE

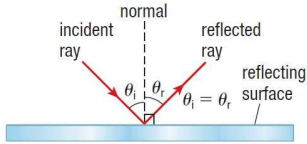
1. Explain what determines:
 - (a) the frequency of a wave,
 - (b) the speed of a wave,
 - (c) the amplitude of a wave, and
 - (d) the wavelength of wave.

(a) the rate of vibration of the source
 (b) the frequency and wavelength of wave
 (c) the amount of energy in the wave
 (d) the rate of vibration of the source

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Properties of Light

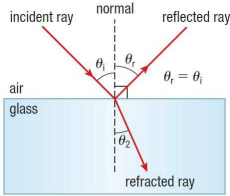
- In many instances, light travels in straight lines, known as **rectilinear** or **straight-line propagation**.
- The change in direction of a light ray after meeting an obstacle is called **reflection**.
- The **Law of Reflection** states that the angle of incidence is equal to the angle of reflection.



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Properties of Light

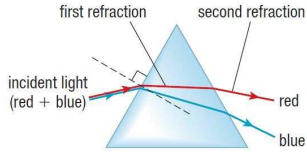
- The bending of light as it travels at an angle from one medium to another is known as **refraction**.
- When a light wave strikes a transparent material, some of the light is reflected from the surface. The rest of the light passes through the material. This is known as **partial reflection – partial refraction**.




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Properties of Light

- The separation of light into its spectral components is known as **dispersion**.



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 Properties of Waves

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2. Two waves with equal speeds have frequencies that differ by a factor of three. What is the ratio of their wavelengths?

if $f_1 = 3f_2$ then $\lambda_1 = 1/3 \lambda_2$

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 Properties of Waves

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3. A wave on a string has a frequency of 0.83 Hz and a wavelength of 0.56 m. Determine the wavelength when a new wave of frequency 0.45 Hz is established on this string and the wave speed does not change.

$\lambda = 1.0 \text{ m}$

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