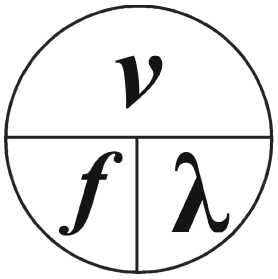
Wave Properties

If you go surfing, you're not looking for a wave up to your ankles. You're looking for a big wave! The size of the wave is known as **amplitude**. The amplitude of a transverse waves is how high the wave rises above or falls below the rest position, or half the distance between the top of the crest and the bottom of the trough. For a longitudinal wave, amplitude is the degree to which the particles are squeezed together during a compression, and spread apart during a rarefaction. As amplitude increases, energy increases. How does the energy and amplitude of a bright light, a loud noise, and a tsunami compare to that of a dim light, a soft sound, or a typical ocean wave?

Waves come in different **wavelengths**. For transverse waves, wavelength is the distance from crest to crest, or from trough to trough. For longitudinal waves, it is the distance from compression to compression, or from rarefaction to rarefaction. Electromagnetic waves vary in length from kilometers for radio waves to less than the diameter of an atom for X-rays and gamma rays. This range is called the electromagnetic spectrum. Visible light is only part of the electromagnetic spectrum.

Wavelength is related to frequency. **Frequency** is the number of wave lengths that pass a given point per second. For transverse waves, it is the number of crests or troughs per second. For longitudinal waves, it is the number of compressions or rarefactions per second. Frequency is measured in wavelengths per second or hertz (Hz). For waves of the same speed, the shorter the wavelength is, the higher the frequency is. Wavelength and the frequency of a wave are inversely proportional. Blue light has a higher frequency and shorter wavelength than red light. A high note has a higher frequency and shorter wavelength than a low note.

Waves travel at different **speeds**. Light waves travel faster than sound waves in air. That's why you see lightning before you hear the thunder. Mechanical waves travel fastest through solids and slowest through gases but not at all in a vacuum. Electromagnetic waves travel fastest in a vacuum, but in a medium, they travel fastest through gases and slowest through solids. Wave speed can be determined using the equation $v = f\lambda$, where v is speed in meters per second [$^{m}/_{s}$], f is frequency in wavelengths per second or hertz [Hz], and λ is wave length in meters [m].



Answer the questions below based on your reading above and on your knowledge of physics.

1. What are four wave properties? _____

2. How is amplitude different for transverse and longitudinal waves? _____

3. How is wavelength different for transverse and longitudinal waves? _____

4. What is frequency? _____

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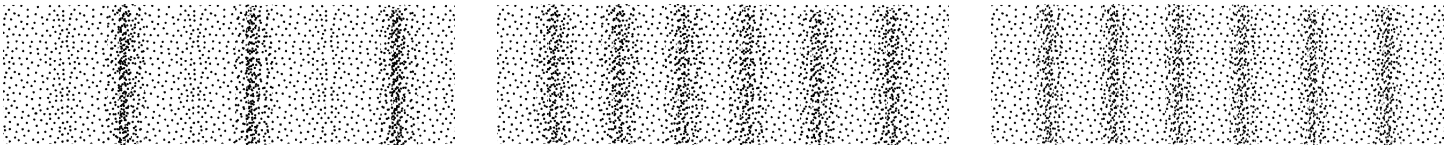
5. Below are three wave diagrams:



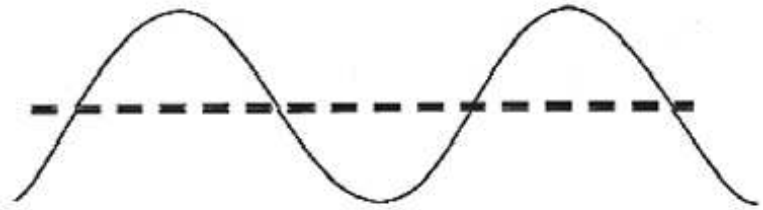
[A] [B] [C]

a. What types of waves are they? _____

b. How is wave [A] different from wave [B]? _____

c. How is wave [B] different from wave [C]? _____

6. What type of wave the diagram below? Label the wavelength and the amplitude. _____



7. In dry air at 20.°C, sound travels at 343.3 $^{m}/_{s}$. Middle C has a frequency of 261.6 Hz. What is its wavelength?

8. The speed of light is 3.00×10^{8} $^{m}/_{s}$. Green light has a wavelength of 6.30×10^{-7} *m*. What is its frequency?

9. FM radio broadcasts at 1.00×10^{8} Hz. If radio waves travel at the speed of light, what is the wavelength of an FM radio wave?

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