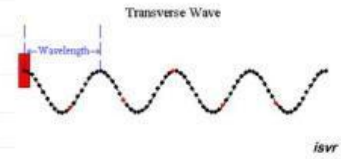


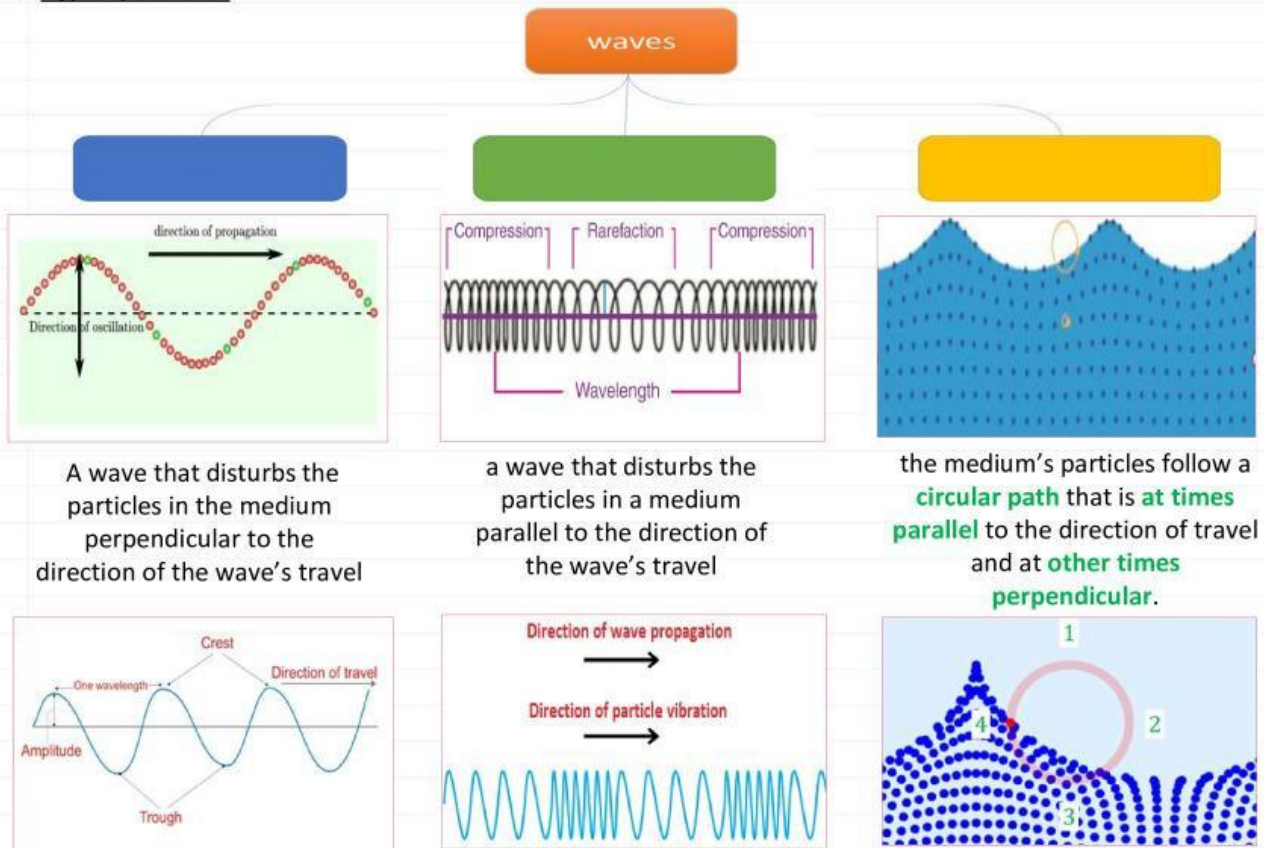
Section 1.2 wave properties

Mechanical waves

- _____ a disturbance that carries energy through matter or space without transferring matter.
- _____ : waves that travel in a physical medium
- Example of mechanical waves: _____
- _____ a single bump or disturbance that travels throughout the medium
- _____ a train of wave pulses that results from continuous disturbance of the particles in a medium at a constant rate.



Types of waves

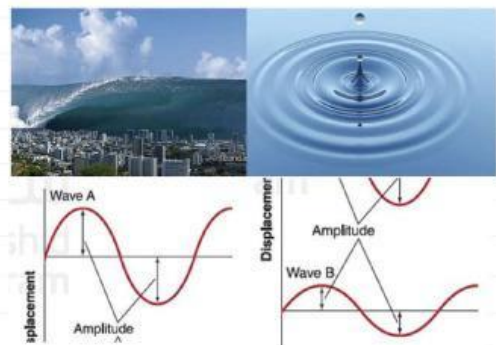


Wave properties

1. Amplitude(A)(m)

Amplitude : it is the greatest displacement from the equilibrium position

Which wave will have a bigger amplitude ?



Section 1.2 wave properties

Wave properties

2. Energy

Waves with bigger amplitudes transfer more energy.

For the same speed, The energy transferred by a wave is proportional **to the square of the amplitude** of the wave.

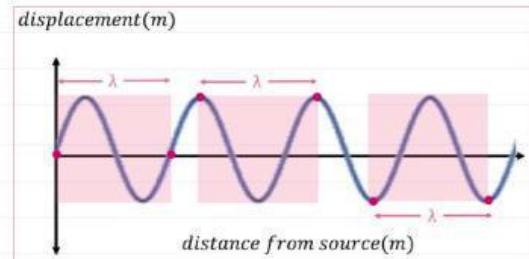
If we double the amplitude of the wave, by which factor will the energy of the wave increase?

3. wavelength(λ)(m)

Wavelength: the shortest distance between points where the wave pattern repeats itself

Trough: the lowest point in a transverse wave

Crest: the highest point in a transverse wave



4. Speed (v)(m/s)

- the speed of a wave is calculated the same way it is calculated for linear motion

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

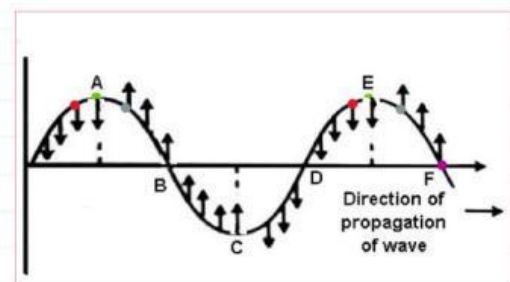
- wave speed **does not depend on amplitude, frequency or wavelength**. Speed depends only on the matter and temperature of the **medium** through which the waves move in

Material	Speed of Sound (m/s)
Air	343
Wood	3960
Water	1493

Temperature (°C)	Speed of Sound in Air (m/s)
-1.0	330.4
20	343.0
45	358.0

5. phase

- Any two points on a wave that are one or more whole wavelengths apart are said to be **in phase**
- Particles in a medium are said to be **in phase** when they have the **same displacement from the equilibrium point and the same velocity**.
- Particles with opposite displacements from the equilibrium position and opposite velocities are **180 degrees out of phase**
- A crest and a trough, for example are 180 degrees out of phase



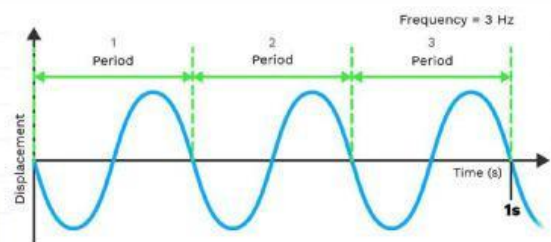
6. Period(T)(s) and frequency(f)(Hz):

- Period**: the time it takes for the motion to complete one cycle.
- Frequency**: the number of complete oscillations a point on a wave makes each second.
- The unit of frequency is **Hz**, where $1 \text{ Hz} = 1/\text{s} = \text{s}^{-1}$

Frequency of a Wave

The frequency of a wave is equal to the reciprocal of the period.

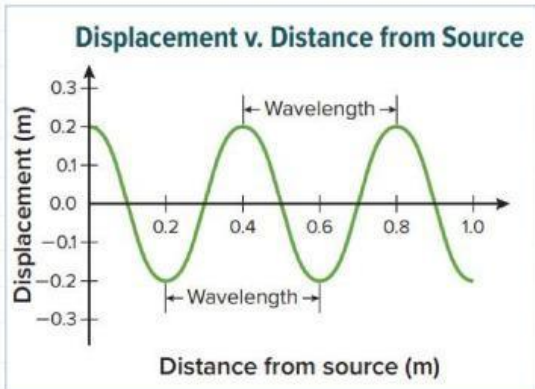
$$f = \frac{1}{T}$$



- depend only on **the wave's source**. They do not depend on the wave's speed or the medium.

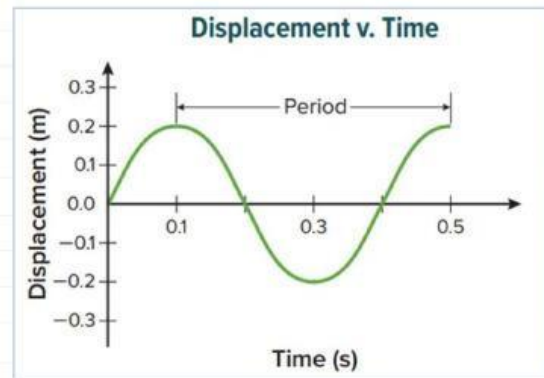
Section 1.2 wave properties

Graphing waves



From this graph you can extract the following properties:

1. Amplitude
2. Wavelength



From this graph you can extract the following properties:

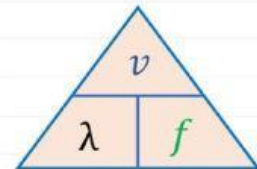
1. Amplitude
2. period

Calculating wavelength

Wavelength

The wavelength of a wave is equal to the velocity divided by the frequency.

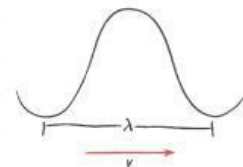
$$\lambda = \frac{v}{f}$$



EXAMPLE Problem 3

A sound wave has a frequency of 192 Hz and travels the length of a football field, 91.4 m, in 0.271 s.

- a. What is the speed of the wave?
- b. What is the wavelength of the wave?
- c. What is the period of the wave?
- d. If the frequency were changed to 442 Hz, what would be the new wavelength and period?



homework

14. A sound wave produced by a clock chime is heard 515 m away 1.50 s later.
 - a. Based on these measurements, what is the speed of sound in air?
 - b. The sound wave has a frequency of 436 Hz. What is the period of the wave?
 - c. What is its wavelength?

16. What is the speed of a periodic wave disturbance that has a frequency of 3.50 Hz and a wavelength of 0.700 m?

17. How does increasing the wavelength by 50 percent affect the frequency of a wave on a rope?

19. Five wavelengths are generated every 0.100 s in a tank of water. What is the speed of the wave if the wavelength of the surface wave is 1.20 cm?

20. A periodic longitudinal wave that has a frequency of 20.0 Hz travels along a coiled spring toy. If the distance between successive compressions is 0.600 m, what is the speed of the wave?

21. How does the frequency of a wave change when the period of the wave is doubled?

22. Describe the change in the wavelength of a wave when the period is reduced by one-half.

23. If the speed of a wave increases to 1.5 times its original speed while the frequency remains constant, how does the wavelength change?

24. CHALLENGE A hiker shouts toward a vertical cliff as shown. The echo is heard 2.75 s later.

- a. What is the speed of sound of the hiker's voice in air?
- b. The wavelength of the sound is 0.750 m. What is its frequency?
- c. What is the period of the wave

