

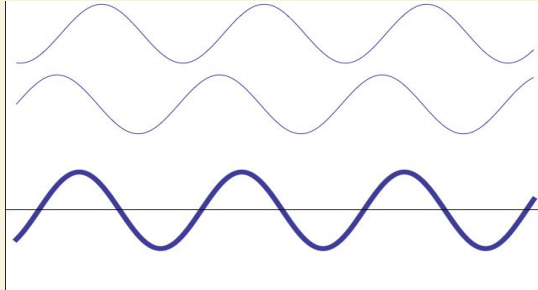
02 Speed of Waves

FAQ

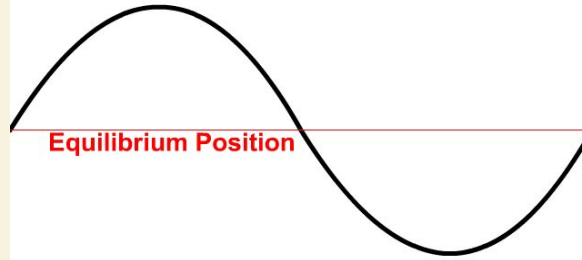
Wavelength

Symbol = λ
Unit = m

Phase



Equilibrium Point



Examples

Longitudinal: sound, ultrasound, shock waves
Transverse: microwaves, light waves, ripples

Longitudinal Waves

waves where the disturbance moves in the same direction as the wave

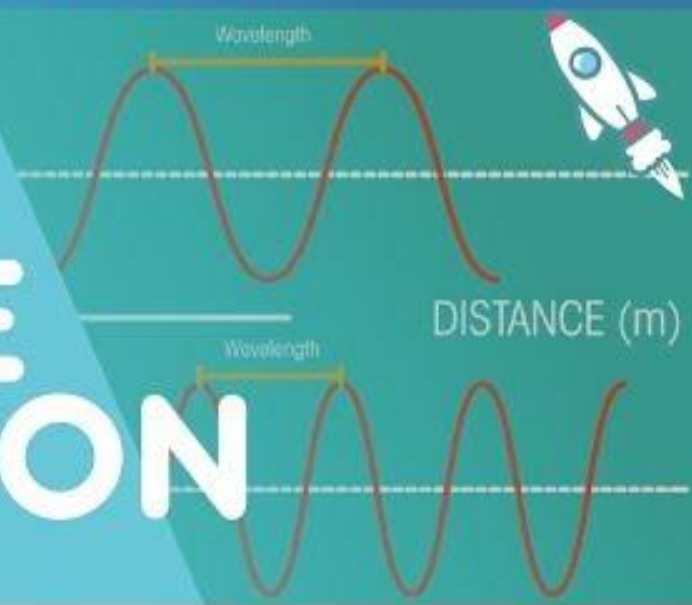
Mechanical waves

waves that require a medium

WAVELENGTH

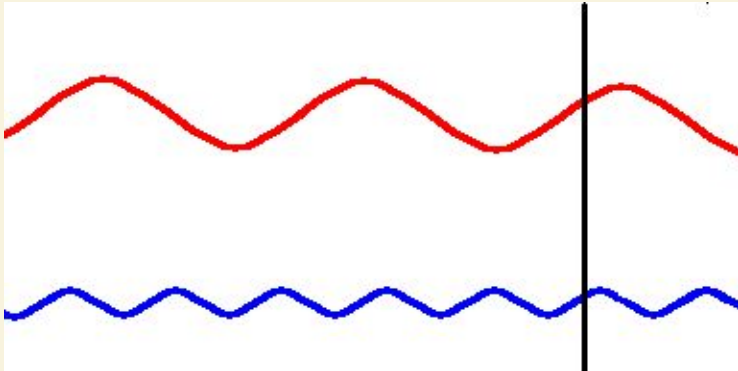
Physics

WAVE MOTION



Frequency (f)

The number of cycles that are completed in a unit of time, it is measured in 1/seconds or hertz (Hz)



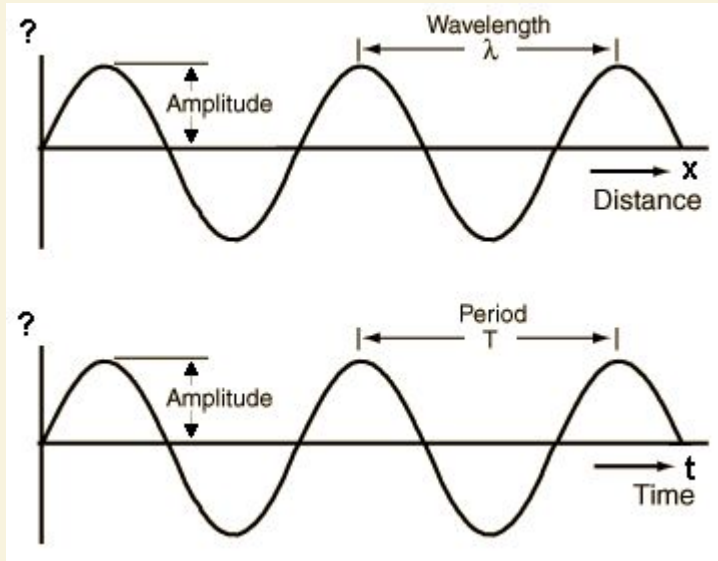
Low Frequency

High Frequency

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

Period (T)

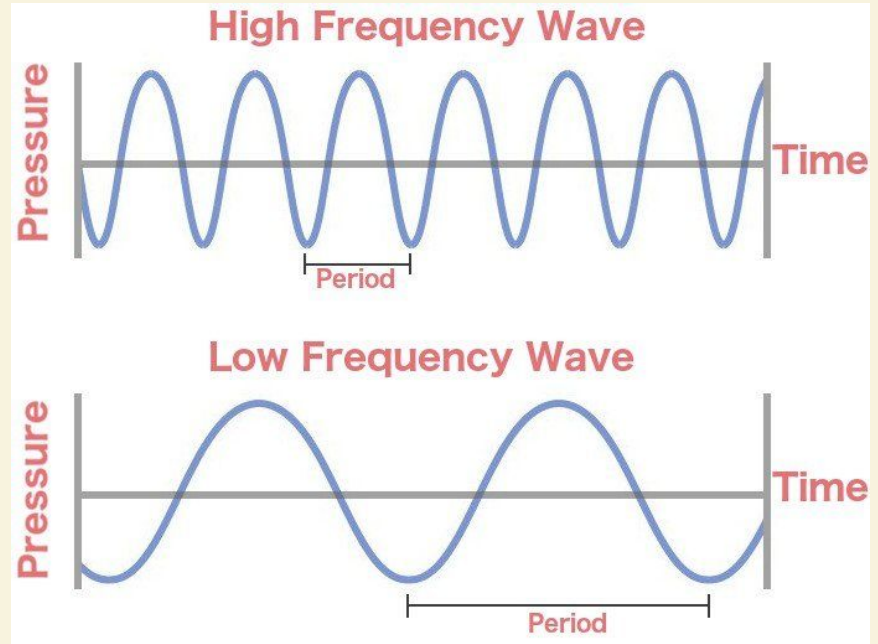
The time it takes for the wave to complete one cycle, it is measured in seconds (s).



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

Period and frequency are the inverse of each other!

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



Physics

WAVE EQUATION

Speed

Frequency

Wavelength



Speed of a wave

From kinematics we know that speed can be calculated using:

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

For waves our distance is the wavelength and the time is the period, so the equation becomes

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

Speed is measured in meters per second (m/s)

Universal Wave Equation

We know that period is the inverse of frequency, so we have

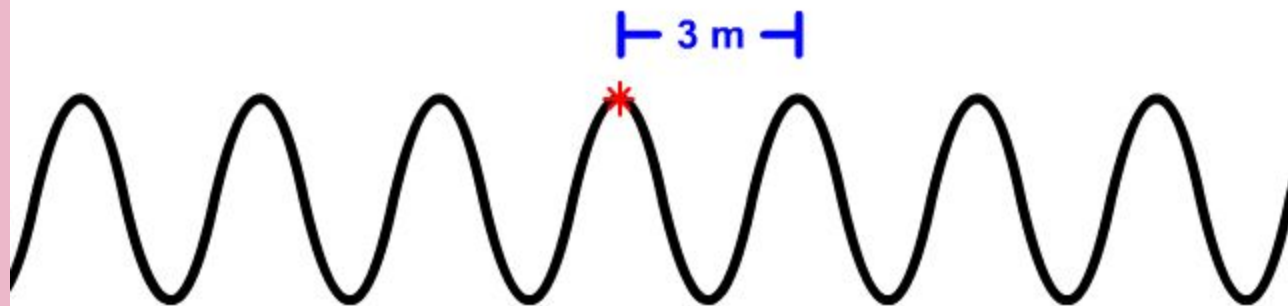
$$T = \frac{1}{f}$$

We can substitute this into our equation to get

$$v = \lambda f$$

This is known as the **universal wave equation**

$$v = (\lambda)(f)$$



3 meters per wave
2 waves per second

Waves in a String

The speed of wave in a string depends on the linear density of the material of the string, we can find this using the mass and length of the string, we get

$$\mu = \frac{m}{L}$$

It also depends on the force of tension in the rope, the speed of the wave in a string is then

$$v = \sqrt{\frac{F_T}{\mu}}$$

So we can see that a larger force of tension leads to a higher wave speed and a high linear density leads to a lower wave speed.

A Wave on a Rope



The effect of temperature

Higher temperatures can increase the speed of the wave, this is because when hotter particles are more efficient at transferring kinetic energy.

