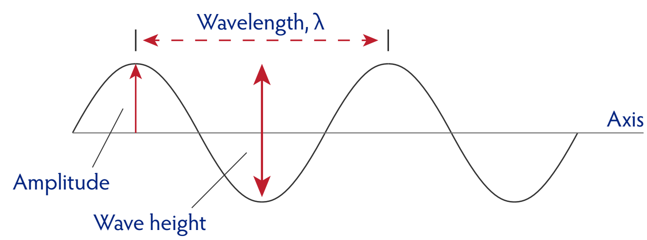
Waves

Definitions



- *Amplitude* - The distance from the axis to the top of a peak or bottom of a trough.
- *Axis* - The vertical midpoint of the wave; the direction along which the wave moves.
- *Frequency (ν or f)* - The number of waves that pass a point in a second. (The ν symbol is the Greek "nu," not a Roman "v.") Frequency is measured in waves per second, called "*Hertz*" (Hz).
- *Period (T)* - The time between adjacent waves, usually measured in seconds.
- *Wave height* - The vertical distance between the bottom of the troughs and the top of the peaks. This is equal to twice the amplitude.
- *Wavelength (λ)* - The distance between adjacent waves. Usually measured in meters.

Numbers

Speed of sound = 343 m/s (in air at 20°C and 1 atmosphere)

Speed of light, $c = 3.00 \times 10^8$ m/s (in vacuum)

Equations

Basics

$$f = \frac{\text{waves}}{\text{seconds}}$$

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

T *- Period, s;* ***f*** *- frequency, Hz*

$$v = \lambda f$$

v *- velocity, m/s;* ***λ*** *- wavelength, m;* ***f*** *- frequency, Hz*

$$\lambda = vT$$

λ *- wavelength, m;* ***v*** *- velocity, m/s;* ***T*** *- Period, s;*

Speed of Sound in Dry Air (approx.)

$$v \approx 331.3 + (0.6T)$$

v *- velocity, m/s;* ***T*** *- Temperature, °C (not °K)*

Doppler Effect

Full version

$$f_o = \frac{v + v_o}{v - v_s} f$$

f_o - *Observed frequency, Hz;* **f** - *Actual frequency, Hz*
v - *velocity of waves, m/s (i.e., speed of sound or light)*
v_s - *Velocity of source, m/s; Negative if source moves away from observer*
v_o - *Velocity of observer, m/s; Negative if observer moves away from source*

Observer Stationary

$$f_o = \frac{v}{v - v_s} f$$

f_o - *Observed frequency, Hz;* **f** - *Actual frequency, Hz*
v - *velocity of waves, m/s (i.e., speed of sound or light)*
v_s - *Velocity of source, m/s; Negative if source moves away from observer*

Advanced

Sound

Speed of Sound in a Gas

$$v = \sqrt{\frac{\gamma R T}{M}}$$

v - *Speed of sound;* **γ** - *Adiabatic index (C_p/C_v);* **T** - *Temperature, K;*
R - *Universal Gas Constant (8.314);* **M** - *Molar mass (kg/mol)*

Sound Intensity and Loudness

$$I = \frac{P}{A} = \frac{P}{4\pi r^2}$$

I - *Intensity, W/m^2;* **A** - *Cross-sectional area, m^2;*
P - *Power of source, Watts;* **r** - *Distance from source, m*

$$\beta = 10 \log \left(\frac{I}{I_0} \right)$$

ß - *Loudness, dB;* **I** - *Sound intensity, W/m^2;* **I_o** - *Constant, 1×10^{-12}*
P - *Power of source, Watts;* **r** - *Distance from source*