Acoustics

- Displacement, Velocity, Acceleration, Force, Friction, & Intensity
- Simple Harmonic Motion, Frequency & Dampening
- Parameters of Sound Waves
- Complex Waves
- Fundamental Frequency & Harmonics
- Standing Waves & Resonance

Displacement (d) is defined as the moving of something from its place or position. A displacement is a vector whose length is the shortest distance from the initial to the final position of point P. It quantifies both the distance and direction of a motion along a straight line from the initial position to the final position. Velocity (v) is equal the amount of displacement that occurs over time (v=d/t). The change in velocity over time is known as the acceleration (a). The outside influence that makes a stationary object move or causes a change in a moving object to change speed or direction is called a force (F). A force that opposes the motion is called friction. Intensity (I) develops when power is distributed over area (I=P/A).

A simple harmonic motion can be seen when striking a vibrating tuning fork. The two prongs will vibrate as mirror images of each other and one complete round trip of an oscillating motion is called a cycle. The numbers of cycles that occur in one second is called frequency. These oscillations do not continue forever, they dissipate over time and eventually die out completely. This process of the vibrations dying out is called dampening, and it occurs due to friction. Pure tone sounds exhibit a simple harmonic motion as well as sinusoidal waves (or sine waves).

The parameters of sound waves include a cycle, which is one complete replication of a vibratory pattern. The period of the wave is the duration of one cycle and a periodic sound repeats itself over a specific time. The number of times a waveform repeats itself in one second is its frequency, or the number of cycles per second, and it is expressed in Hz. The amplitude of the wave is the size of the wave, such as the amount of displacement. The distance covered by one cycle of a prorogating wave is called the wavelength.

When two or more pure tones are combined, the result is called a complex wave. Complex waves can contain any number of frequencies. Complex periodic waves have waveforms that repeat themselves over time, if the waveform does not repeat itself over time it is considered a complex aperiodic wave.

The lowest frequency component of a complex periodic wave its fundamental frequency. Harmonics are whole number or multiples of the fundamental frequency. So, in other words the fundamental frequency is the largest whole number common denominator of a wave's harmonics, and the harmonics are integral multiples of the fundamental frequency – the fundamental frequency is also considered a harmonic because it is equal to 1 times itself.

The frequencies at which a medium vibrates the most are called resonant frequencies. The differences in resonant frequency ranges enable different devices or other objects to act as filters by transmitting energy more readily for certain frequency ranges over others.