1 General Wave Properties

Preamble

Waves are a fundamental method of describing the nature of matter and how it interacts with energy. In this chapter we will be covering general wave properties that would be helpful.

1.1 Definitions

Definition 1.1: Wave

A wave is the transfer of energy without the transfer of matter.

Definition 1.2: Transverse Wave

A transverse wave is when the particles oscillate perpendicular to the direction of propagation.

An example of a transverse wave is electromagnetic waves.

Definition 1.3: Longitudinal Wave

A longitudinal wave is when the particles oscillate parallel to the direction of propagation.

An example of a longitudinal wave is sound waves.

1.2 Parts of a Wave

1.2.1 Common Quantities

Definition 1.4: Amplitude

The amplitude of a wave is the maximum displacement of a particle in a wave. It is usually represented by the letter A. The most common unit for amplitude is the metre [m]; though keep in mind other physical quantities like voltage can exhibit periodic wave-like behaviour.

Definition 1.5: Wavelength

The wavelength of a wave is the displacement between two successive in-phase points. It is usually represented by the Greek letter λ. The SI unit for wavelength is the metre [m].

Definition 1.6: Wavefront

A wavefront is an imaginary line on a wave that joins all adjacent points that are in phase.

1.2.2 Time-based Quantities

Definition 1.7: Period

The period of a wave is the time taken for a particle to complete one oscillation. It is usually represented by the letter T. The SI unit for period is the second [s].

Definition 1.8: Frequency

The frequency of a wave is the number of times a particle completes one oscillation in one second. It is usually represented by the letter f. The SI unit for frequency is the hertz [Hz].

Equation 1.1: Period and Frequency

Period and frequency are reciprocals of each other,

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

1.2.3 Some Things Specific to Longitudinal Waves

Definition 1.9: Compression

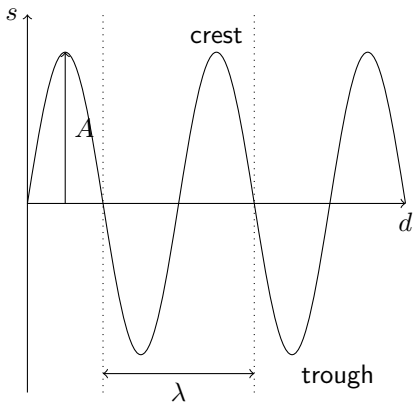
A compression in a longitudinal wave is where there are more particles around that region than in equilibrium.

Definition 1.10: Rarefaction

A rarefaction in a longitudinal wave is where there are less particles around that region than in equilibrium.

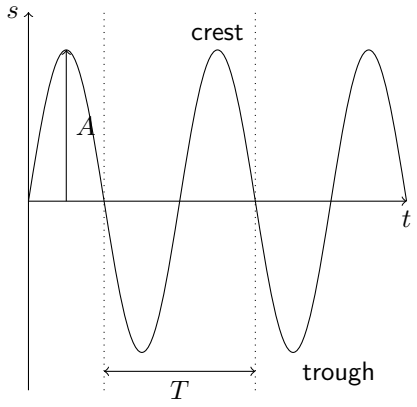
1.2.4 Displacement-distance Graph

This is also known as a snapshot graph.



1.2.5 Displacement-time Graph

This is also known as a history graph.



1.3 Wave Equation

Equation 1.2: Wave Equation

For a wave with frequency f and wavelength λ, the velocity v it is travelling at is equal to

$$v = f\lambda$$