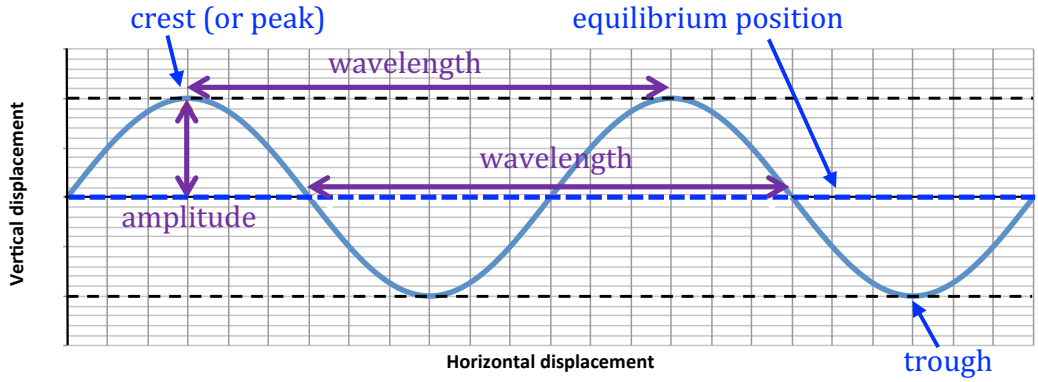
6.1.1 Properties of waves

Waves are oscillations (vibrations) which carry energy from one place to another. Waves which travel in a medium (a material) cause the particles in the medium to be displaced from their equilibrium position. One example is a water wave.

videos

Let's consider a water wave:



We can see a 'snapshot' of the wave at a certain time. The vertical displacement is shown for particles at different horizontal positions.

(1) What is the height of the wave (from the equilibrium position) called?

(2) What is the length of one wave called?

(3) What is the top of the wave called?

(4) What is the bottom of the wave called?

(5) What unit could be used for wavelength?

(6) Describe how you would measure one wavelength.

The frequency of the waves is the number of waves that pass a fixed point in one second.

$$frequency = \frac{number\ of\ waves\ passing}{time\ (seconds)}$$

Frequency is measured in hertz (Hz).

(7) Imagine that you are in a boat that is bobbing up and down as waves pass underneath. You count the 30 waves passing in one minute. What is the frequency of the waves?

The speed of the wave is the distance travelled by a wave crest in one second.

$$wave\ speed = \frac{distance\ moved\ by\ crest}{time\ (seconds)}$$

(8)✎ A wave crest travels 120 metres in 1 minute. What is the wave speed?

The period of a wave is the time (in seconds) for one wave to pass. The period is related to the frequency:

$$period = \frac{1}{frequency}$$

(9)✎ What is the period of a wave with a frequency of 50Hz?

(10)✎ What is the frequency of a wave with a period of 0.125 seconds?

The wave equation

The wave equation gives the relationship between wave speed, wavelength and frequency.

$$wave\ speed = frequency \times wavelength$$

$$v = f \times \lambda$$

We use the Greek letter 'lambda' as the symbol for wavelength

(11)✎ A wave has a frequency of 1.2 Hz and a wavelength of 150 m. What is the wave speed?

(12)✎ A wave is travelling at a speed of 340 m/s and has a frequency of 280 Hz. What is its wavelength?

(13)✎ A wave is travelling at a speed of $3 \times 10^8\ m/s$ *and has a wavelength of 0.25m. What is its frequency?*

(14)✎ A wave is travelling at the speed of light (see below) and has a frequency of 200 MHz. What is its wavelength? (Note: 1 MHz = 1 million hertz)

Note: The speed of sound is approximately 340 m/s. The speed of light (and other electromagnetic waves) is $3 \times 10^8\ m/s$ in a vacuum.