ACTIVITY 1-2 Wavelength and Frequency

The frequency of a wave is defined as the number of waves created per second. As the waves propagate away from the source, the frequency also represents the number of waves that will pass a point per second. The unit of frequency is the hertz (Hz).

The wavelength, or length of a wave, is defined as the distance from one point on a wave to the corresponding point on the next wave. Since wavelength is a distance, the unit of wavelength is the meter (m).

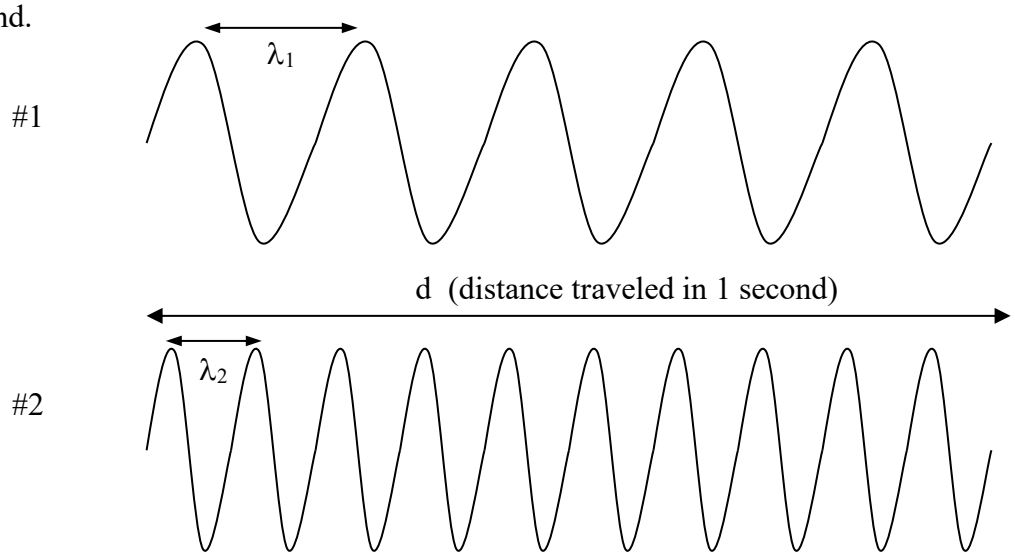
Frequency, wavelength and speed are related by the equation:

$$c = \lambda f$$

where c is the speed of light (3×10^8 m/s),
λ (lambda) is the wavelength in meters (m),
and f is the frequency in hertz (Hz).

From this equation we can see that a long wavelength will have a low frequency while a short wavelength will have a high frequency since the product of these two quantities is constant.

In this diagram, the distance (d) indicated represents the distance the waves travel in 1 second.



Wave #1 has 5 complete waves passing by in one second, while Wave #2 has 10 waves passing by in the same time. If you were to watch Wave #1 pass a point, the frequency would be 5 waves per second – 5 Hz. Wave #2 would have a frequency of 10 hertz. Wave #1 has half the frequency of Wave #2 and two times the wavelength. For both waves, the product of the wavelength and frequency are the same.

Example problem: Find the wavelength of a radio wave with a frequency of 900 kHz.

$f = 900\ \text{kHz} = 900 \times 10^3\ \text{Hz} = 9 \times 10^5\ \text{Hz}$
$c = 3 \times 10^8\ \text{m/s}$
$\lambda = ?$

$$c = \lambda f \qquad \text{(Solve for } \lambda\text{)}$$

$$\frac{1}{f}\, c = \lambda f\, \frac{1}{f}$$

$$\lambda = \frac{c}{f}$$

$$\lambda = \frac{3 \times 10^8}{9 \times 10^5}$$

$$\lambda = .33 \times 10^3 = 3.3 \times 10^2\ \text{m} \qquad (330\ \text{m})$$

Problems

1. Find the wavelength of a radio wave with a frequency of 650 kHz.
2. Find the wavelength of a radio wave with a frequency of 1300 kHz.
3. Find the wavelength of a radio wave with a frequency of 90 MHz.
4. Find the wavelength of a radio wave with a frequency of 101.5 MHz.
5. AM radio stations have frequencies from 540-1700 kHz.
    a) Find the shortest wavelength AM radio signal.
    b) Find the longest wavelength AM radio signal.
6. FM radio stations have frequencies from 88-108 MHz.
    a) Find the longest wavelength FM radio signal.
    b) Find the shortest wavelength FM radio signal.

Answer key for Activity 2.

1. 4.6×10^2 m (460 m)
2. 2.3×10^2 m (230 m)
3. 3.3 m
4. 2.96 m
5a. 1.76×10^2 m (176 m)
5b. 5.56×10^2 m (556 m)
6a. 3.4 m
6b. 2.8 m