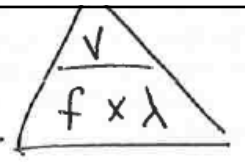
Wave Speed

$v = f\lambda$



1. A wave with a frequency of 60.0 Hz travels through vulcanized rubber with a wavelength of 0.90 m. What is the speed of this wave?

$v = f\lambda = (60.0\,Hz)(0.90\,m) = 54\ m/s$

2. A wave with a frequency of 60.0 Hz travels through steel with a wavelength of 85.5 m. What is the speed of this wave?

$v = f\lambda = (60.0\,Hz)(85.5\,m) = 5130\ m/s$

3. The lowest pitch that the average human can hear has a frequency of 20.0 Hz. If sound with this frequency travels through air with a speed of 331 m/s, what is its wavelength?

$\lambda = \frac{v}{f} = \frac{331\ m/s}{20.0\ Hz} = 16.6\ m$

4. One of the largest organ pipes is in the auditorium organ in the convention hall in Atlantic City, New Jersey. The pipe is 38.6 ft long and produces a sound with a wavelength of about 10.6 m. If the speed of sound in air is 346 m/s, what is the frequency of this sound?

$f = \frac{v}{\lambda} = \frac{346\ m/s}{10.6\ m} = 32.6\ Hz$

5. A certain FM radio station broadcasts electromagnetic waves at a frequency of 9.05×10^7 Hz. These radio waves travel at a speed of 3.00×10^8 m/s. What is the wavelength of these radio waves?

$\lambda = \frac{v}{f} = \frac{3.00 \times 10^8\ m/s}{9.05 \times 10^7\ Hz} = 0.331 \times 10^1\ m = 3.31\ m$

divide

6. A 10.0 m wire is hung from a high ceiling and held tightly below by a large mass. Standing waves are created in the wire by air currents that pass over the wire, setting it in motion. If the speed of the standing wave is 335 m/s and its frequency is 67 Hz, what is its wavelength?

$$\lambda = \frac{v}{f} = \frac{335\ m/s}{67\ Hz} = 5.0\ m$$

7. A dolphin can typically hear sounds with frequencies up to 150 kHz. What is the speed of sound in water if a wave with this frequency has a wavelength of 1.0 cm?

convert!

$$v = f\lambda = (150{,}000\ Hz)(0.010\ m)$$
$$= 1500\ m/s$$

8. Earthquakes generate shock waves that travel through Earth's interior to other parts of the world. The fastest of these waves are longitudinal waves, like sound waves, and are called *primary waves*, or just *p-waves*. A p-wave has a very low frequency, typically around 0.050 Hz. If the speed of a p-wave with this frequency is 8.0 km/s, what is its wavelength?

8.0×10^3 m
8,000 m

$$\lambda = \frac{v}{f} = \frac{8.0 \times 10^3\ m}{0.050\ Hz} = 160{,}000\ m/s$$

9. Earthquakes also produce transverse waves that move more slowly than the p-waves. These waves are called *secondary waves*, or *s-waves*. If the wavelength of an s-wave is 2.3×10^4 m, and its speed is 4.5 km/s, what is its frequency?

23,000 m

4500 m/s
4.5×10^3 m/s

$$f = \frac{v}{\lambda} = \frac{4.5 \times 10^3\ m/s}{2.3 \times 10^4\ m}$$

$\frac{4500\ m/s}{23{,}000\ m} = 2.0\ Hz$

$= 2.0 \times 10^{-1}\ Hz$
$= 0.20\ Hz$