

Tier 3 Waves

1. Strong winds can apply a significant enough force to tall skyscrapers to set them into a back-and-forth motion. The amplitudes of these motions are greater at the higher floors and barely observable for the lower floors. It is said that one can even observe the vibrational motion of the Sears Tower in Chicago on a windy day.

a) As the Sears Tower vibrates back and forth, it makes about 8.6 vibrations in 60 seconds. Determine the frequency and the period of vibration of the Sears Tower.

b) treat the top of the Sears tower as an open end and the bottom as a closed end and the building vibrates in the 1st harmonic. What is the wavelength of the wave in the Sears tower?

2. Extreme waves along ocean waters, sometimes referred to as freak waves or rogue waves, are a focus of much research and study among scientists. Several merchant ships reports rogue waves which are estimated to be 25 meters high and 26 meters long. Assuming that these waves travel at speeds of 6.5 m/s, determine the frequency and the period of these waves.

3. Microbats use echolocation to navigate and hunt. They emit pulses of high frequency sound waves which reflect off obstacles and objects in their surroundings. By detecting the time delay between the emitted pulse and the return of the reflected pulse, a bat can determine the location of the object. Determine the time delay between the sending of a pulse and the return of its reflection from an object located 12.5 m away. Approximate the speed of the sound waves as 345 m/s.

4. Sachi is rock'n to her favorite radio station - 102.3 FM. The station broadcasts radio signals with a frequency of 1.023×10^8 Hz. The radio wave signal travel through the air at a speed of 2.997×10^8 m/s. Determine the wavelength of these radio waves.

5. A marine weather station detects waves which are 9.28 meters long and 1.65 meters high and travel a distance of 50.0 meters in 21.8 seconds. Determine the speed and the frequency of these waves.

6. You are building a sonar device to finally get data on the elusive "rods" (crypto-zoology). Rods tend to be small, fast moving and phase in and out of our dimension (it turns out to be a camera trick, but never the less). Which of the following properties below is the most important and why?

High Amplitude

Low Amplitude

High Frequency

Low Frequency

High Energy

Low Energy