Introduction to Waves

Problem Set

1. The speed of a transverse wave in a string is 15.0 m/s. If a source produces a disturbance that has a frequency of 5.00 Hz, what is its wavelength?
2. A periodic longitudinal wave that has a frequency of 20 Hz travels along a coil spring. If the distance between successive compressions is 0.400 m, what is the speed of the wave?
3. If you want to increase the wavelength of waves in a rope, should you shake it at a higher or lower frequency?
4. What is the speed of a periodic wave disturbance that has a period of 5.00 s and a wavelength of 25.0 m?
5. Five pulses are generated every 0.100 s in a tank of water. What is the speed of propagation of the wave if the wavelength of the surface wave is 1.20 cm?

1. A sound wave produced by a clock chime is heard 515 m away 1.50 s later.
   1. What is the speed of sound of the clock’s chime in air?
   2. The sound wave has a frequency of 436 Hz. What is its period?
   3. What is its wavelength?
2. Pepe and Alfredo are resting on an offshore raft after a swim. They estimate that 3.0 m separates a trough and an adjacent crest of surface waves on the lake. They count 14 crests that pass by the raft in 20.0 s. Calculate how fast the waves are moving.
3. A hiker shouts toward a vertical cliff 685 m away. The echo is heard 4.00 s later.
   1. What is the speed of sound of the hiker’s voice in air?
   2. The wavelength of sound is 0.750 m. What is its frequency?
   3. What is the period of the wave?
4. Water waves in a lake travel 4.4 m in 1.8 s. The period of oscillation is 1.2 s.
   1. What is the speed of the water waves?
   2. What is their wavelength?
5. AM-radio signals are broadcast at frequencies between 550 kHz and 1600 kHz (kilohertz) and travel 3.0 x 108 m/s.
   1. What is the range of wavelengths for these signals?

b) FM frequencies range between 88 MHz and 108 MHz (megahertz) and travel at the same speed. Are FM wavelengths longer or shorter than AM wavelengths?

Answers

1. 3.00 m 2. 8 m/s 3. Lower frequency 4. 5 m/s 5. 60 cm/s 6. 343 m/s, 0.79 m, 0.0023 s 7. 4.2 m/s

8. 343 m/s, 457 Hz, 0.0022 s 9. 2.4 m/s, 2.9 m 10. 188 m → 545 m, shorter