Waves PS3

**\*For all problems, use 343 m/s as the speed of sound in air**

**unless otherwise stated or the temperature is not 20° C.**

1. You hear the sound of the firing of a distant cannon 6.0 seconds after seeing the flash. How far are you from the cannon?
2. If you shout across a canyon and hear an echo 4.0 seconds later, how wide is the canyon?
3. A sound wave has a frequency of 9800 Hz and travels along a steel rod. If the distance between compressions, or regions of high pressure, is 0.580 m, what is the speed of the wave?
4. A certain instant camera determines the distance to the subject by sending out a sound wave and measuring the time needed for the echo to return to the camera. How long would it take the sound wave to return if the subject were 3.00 m away?
5. Sound with a frequency of 261.6 Hz travels through water at a speed of 1435 m/s. Find the sound’s wavelength in water.
6. The sound emitted by bats has a wavelength of 3.5 mm in air. What is the sound’s frequency?
7. Ultrasound with a frequency of 4.25 MHz can be used to produce images of the human body. If the speed of sound in the body is the same as in salt water, 1.50 km/s, what is the wavelength of the pressure wave in the body?
8. A 440-Hz tuning fork is in a room at 32° C. What is the wavelength of a sound emitted by the tuning fork?

Answers

PS3

1. 2058 m 2. 686 m 3. 5684 m/s 4. 0.0175 s 5. 5.5 m 6. 98,000 Hz

7. 3.53 x 10-4 m 8. 0.80 m

PS4

1. 566 Hz, 448 Hz 2. 335 Hz, 315 Hz 3. 475 Hz, 338 Hz 4. 44 Hz 5. 43,207 Hz

PS5

1. 0.84 Hz, 1.19 s 2. 1.26 m, 0.0038 s, 0.61 s 3. 2235 m 4. 1727 Hz, 1490 Hz 5. 5 Hz 6. 651 m/s 7. 294 Hz

(PS4 and PS5 on reverse side.)Waves PS4

1. A train moving at a speed of 40 m/s sounds its whistle, which has a frequency of 500 Hz. Determine the frequency heard by a stationary observer as the train
   1. approaches.
   2. recedes.
2. A train moving toward a detector at 31 m/s blows a 305-Hz horn. What frequency is detected by a
   1. stationary train?
   2. train moving away from the first train at a speed of 21 m/s?
3. An ambulance travels down the highway at a speed of 75 mph (33.5 m/s). Its siren emits sound at a frequency of 400 Hz. What is the frequency heard by a passenger in a car traveling at 55 mph (24.6 m/s) in the opposite direction as the car
   1. approaches the ambulance?
   2. moves away from the ambulance?
4. Two cars are equipped with the same 400-Hz horn. When both cars drive towards each other at 18 m/s with their horns sounding, what beat frequency is observed by each driver?
5. A bat at rest sends out ultrasonic waves at 50,000 Hz and receives them returned from an object moving away at 25.0 m/s. What is the received sound frequency?

Waves PS5

1. A slinky vibrates 42 times in 50 seconds.
   1. What is the frequency of vibration?
   2. What is the period?
2. A sound wave in air has a frequency of 262 Hz and travels with a speed of 330 m/s.
   1. How far apart are the compressions?
   2. What is the period of the wave?
   3. How long does it take the sound wave to travel 200 m?
3. A sailor strikes the side of his ship just below the surface of the sea. He hears the echo of the wave reflected from the ocean floor directly below 3.0 s later. How deep is the ocean at this point? (The speed of sound through ocean water is 1490 m/s).
4. The predominant frequency of a certain police car’s siren is 1600 Hz when at rest. The speed of sound in air is 340 m/s. What is the detected frequency if the car is
   1. moving toward an observer at 25 m/s?
   2. moving away from an observer at 25 m/s?
5. Two horns emitting sounds of frequency 556 Hz and 561 Hz, respectively, produce beats of what frequency?
6. An airplane travels at Mach 2.1 where the speed of sound is 310 m/s. How fast is the airplane traveling?
7. A train travels towards an observer at 30 m/s and sounds its horn of frequency 280 Hz. While the train is moving towards the observer, the observer moves away from the train at a speed of 15 m/s. What frequency does the observer detect if the speed of sound is 340 m/s?