

Unit Review: Sound Waves

Note: The speed of sound in air is 343 m/s unless the question says otherwise.

1. What are the physical characteristics of sound waves?
2. In the nineteenth century, people put their ears to a railroad track to get an early warning of an approaching train. Why did this work?
3. How must the length of an open tube compare to the wavelength of the sound to produce the strongest resonance?
4. What behaviors do sound waves exhibit? What behavior causes beats?
5. Does the Doppler shift occur for only some types of waves, or for all types of waves?
6. What property distinguishes notes played on both a trumpet and a clarinet if they have the same pitch and loudness?
7. The speed of sound increases by about 0.6 m/s for each degree Celsius when the air temperature rises. For a given sound, as the temperature increases, what happens to
 - a) its frequency?
 - b) its wavelength?
8. In a Star Trek episode, a space station orbiting a planet blows up. The crew of the Enterprise immediately hears and sees the explosion. If you had been hired as an advisor, what two physics errors would you have found and corrected?
9. Suppose the horns of all cars emitted sound at the same pitch or frequency. What would be the change in the frequency of the horn of a car moving
 - a) toward you?
 - b) away from you?
10. A bat emits short pulses of high-frequency sound and detects echoes.
 - a) In what way would the echoes from large and small insects compare if they were the same distance from the bat?
 - b) In what way would the echo from an insect flying toward the bat differ from that of an insect flying away from the bat?

11. If the pitch of sound is increased, what are the changes in
 - a) the frequency?
 - b) the wavelength?
 - c) the wave speed?
 - d) the amplitude of the wave?
12. The speed of sound increases with temperature. Would the pitch of a closed pipe increase or decrease when the temperature of the air rises?
13. Two flutes are tuning up. If the conductor hears the beat frequency increasing, are the two flute frequencies getting closer together or farther apart?
14. A sound wave of wavelength 0.70 m and velocity 330 m/s is produced for 0.50 s .
 - a) What is the frequency of the wave?
 - b) How many complete waves are emitted in this time interval?
 - c) After 0.50 s , how far is the front of the wave from the source of the sound?
15. The speed of sound in water is 1498 m/s . A sonar signal is sent straight down from a ship at a point just below the water surface, and 1.8 s later the reflected signal is detected. How deep is the ocean beneath the ship?
16. You hear the sound of the firing of a distant cannon 6.0 s after seeing the flash. How far are you from the cannon?
17. If you shout across a canyon and hear an echo 4.0 s later, how wide is the canyon?
18. A rifle is fired in a valley with parallel vertical walls. The echo from one wall is heard 2.0 s after the rifle was fired. The echo from the other wall is heard 2.0 s after the first echo. How wide is the valley?
19. 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 to the camera if the subject were 3.0 m away?
20. 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.
21. If the wavelength of a 440 Hz sound in freshwater is 3.3 m , what is the speed of sound in water?

22. Sound with a frequency of 442 Hz travels through steel. A wavelength of 11.66 m is measured. Find the speed of the sound in steel.
23. The sound emitted by bats has a wavelength of 3.5 mm . What is the sound's frequency in air?
24. 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, 1.5 km/s , what is the wavelength of the pressure wave in the body?
25. A rock band plays at an 80 dB sound level. How many times greater is the sound intensity from another rock band playing at
- a) 100 dB ?
 - b) 120 dB ?
26. If you drop a stone into a mine shaft 122.5 m deep, how soon after you drop the stone do you hear it hit the bottom of the shaft?
27. An open vertical tube is filled with water, and a tuning fork vibrates over its mouth. As the water level is lowered in the tube, resonance is heard when the water level has dropped 17 cm , and again after 49 cm . What is the frequency of the tuning fork?
28. One tuning fork has a 445 Hz pitch. When a second tuning fork is struck, beats occur with a frequency of 3 Hz . What are the two possible frequencies of the second tuning fork?
29. A flute acts as an open pipe and sounds a note with a 370 Hz pitch. What are the frequencies of the second, third, and fourth harmonics of this pitch?
30. A clarinet sounds the same note, with a pitch of 370 Hz , as in problem 29. the clarinet, however, produces harmonics that are only odd multiples of the fundamental frequency. What are the frequencies of the lowest three harmonics produced by the clarinet?