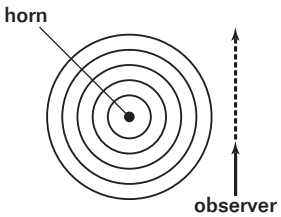
9. The horn of a parked automobile is stuck. If you are in a vehicle that passes the automobile, as shown below, what is the nature of the sound that you hear?

A. The original sound of the horn rises in pitch.
B. The original sound of the horn drops in pitch.
C. A lower pitch is heard rising to a higher pitch.
D. A higher pitch is heard dropping to a lower pitch.



10. The second harmonic of a guitar string has a frequency of 165 Hz. If the speed of waves on the string is 120 m/s, what is the string's length?

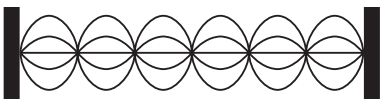
F. 0.36 m
G. 0.73 m
H. 1.1 m
J. 1.4 m

SHORT RESPONSE

11. Two wind instruments produce sound waves with frequencies of 440 Hz and 447 Hz, respectively. How many beats per second are heard from the superposition of the two waves?

12. If you blow across the open end of a soda bottle and produce a tone of 250 Hz, what will be the frequency of the next harmonic heard if you blow much harder?

13. The figure below shows a string vibrating in the sixth harmonic. The length of the string is 1.0 m. What is the wavelength of the wave on the string?



14. The power output of a certain loudspeaker is 250.0 W. If a person listening to the sound produced by the speaker is sitting 6.5 m away, what is the intensity of the sound?

EXTENDED RESPONSE

Use the following information to solve problems 15–16. Be sure to show all of your work.

The area of a typical eardrum is approximately equal to 5.0×10^{-5} m^2.

15. What is the sound power (the energy per second) incident on the eardrum at the threshold of pain (1.0 W/m^2)?

16. What is the sound power (the energy per second) incident on the eardrum at the threshold of hearing (1.0×10^{-12} W/m^2)?

Use the following information to solve problems 17–19. Be sure to show all of your work.

A pipe that is open at both ends has a fundamental frequency of 456 Hz when the speed of sound in air is 331 m/s.

17. How long is the pipe?

18. What is the frequency of the pipe's second harmonic?

19. What is the fundamental frequency of this pipe when the speed of sound in air is increased to 367 m/s as a result of a rise in the temperature of the air?

Test TIP Be certain that the equations used in harmonic calculations are for the right kind of sound source (vibrating string, pipe open at both ends, or pipe closed at one end).