Questions

1. What is the evidence that sound travels as a wave?
2. What is the evidence that sound is a form of energy?
3. Children sometimes play with a homemade "telephone" by attaching a string to the bottoms of two paper cups. When the string is stretched and a child speaks into one cup, the sound can be heard at the other cup (Fig. 12–29). Explain clearly how the sound wave travels from one cup to the other.

FIGURE 12–29 Question 3.

4. When a sound wave passes from air into water, do you expect the frequency or wavelength to change?
5. What evidence can you give that the speed of sound in air does not depend significantly on frequency?
6. The voice of a person who has inhaled helium sounds very high-pitched. Why?
7. How will the air temperature in a room affect the pitch of organ pipes?
8. Explain how a tube might be used as a filter to reduce the amplitude of sounds in various frequency ranges. (An example is a car muffler.)
9. Why are the frets on a guitar (Fig. 12–30) spaced closer together as you move up the fingerboard toward the bridge?

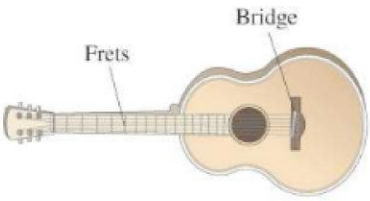

FIGURE 12–30 Question 9.

10. A noisy truck approaches you from behind a building. Initially you hear it but cannot see it. When it emerges and you do see it, its sound is suddenly "brighter"—you hear more of the high-frequency noise. Explain. [*Hint*: See Section 11–15 on diffraction.]
11. Standing waves can be said to be due to "interference in space," whereas beats can be said to be due to "interference in time." Explain.
12. In Fig. 12–16, if the frequency of the speakers were lowered, would the points D and C (where destructive and constructive interference occur) move farther apart or closer together?
13. Traditional methods of protecting the hearing of people who work in areas with very high noise levels have consisted mainly of efforts to block or reduce noise levels. With a relatively new technology, headphones are worn that do not block the ambient noise. Instead, a device is used which detects the noise, inverts it electronically, then feeds it to the headphones *in addition to* the ambient noise. How could adding *more* noise reduce the sound levels reaching the ears?
14. Consider the two waves shown in Fig. 12–31. Each wave can be thought of as a superposition of two sound waves with slightly different frequencies, as in Fig. 12–18. In which of the waves, (a) or (b), are the two component frequencies farther apart? Explain.

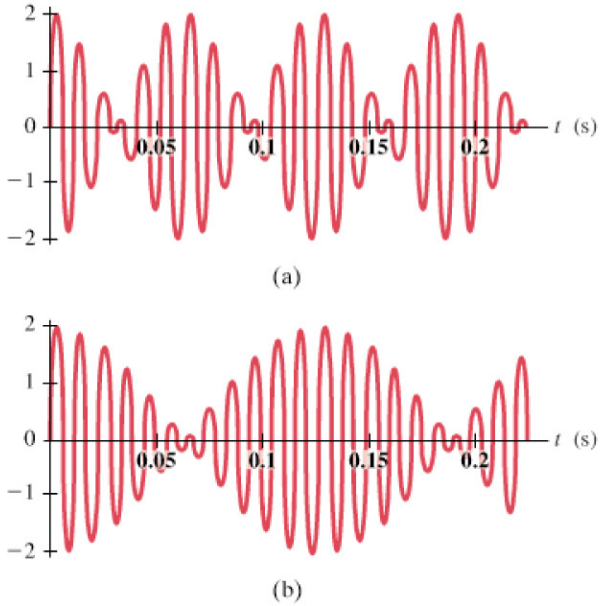

FIGURE 12–31 Question 14.

15. Is there a Doppler shift if the source and observer move in the same direction, with the same velocity? Explain.
16. If a wind is blowing, will this alter the frequency of the sound heard by a person at rest with respect to the source? Is the wavelength or velocity changed?
17. Figure 12–32 shows various positions of a child in motion on a swing. A monitor is blowing a whistle in front of the child on the ground. At which position, A through E, will the child hear the highest frequency for the sound of the whistle? Explain your reasoning.

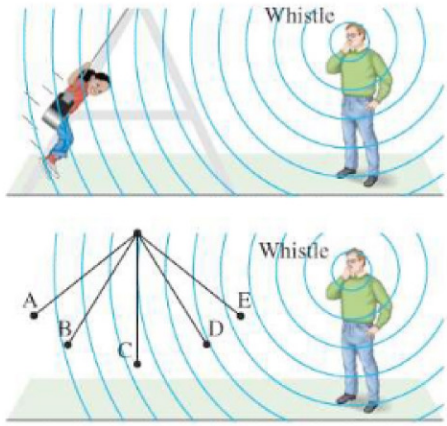

FIGURE 12–32 Question 17.