

Assessment

Sound**Teacher Notes and Answers****12 Sound****HARMONICS**

1. d
2. d
3. b
4. c
5. c
6. a

Given

$$v = 488 \text{ m/s}$$

$$f_1 = 1250 \text{ Hz}$$

Solution

$$f_n = n \frac{v}{2L}; 2Lf_n = nv; L = \frac{nv}{2f_n}$$

For the fundamental frequency, $n = 1$, so

$$L = \frac{v}{2f_1} = \frac{488 \text{ m/s}}{2(1250 \text{ Hz})} = 0.195 \text{ m} = 19.5 \text{ cm}$$

7. d
8. c

9. The sound waves of the two notes interfere constructively and then destructively resulting in alternating loud and soft moments. The number of these louder-softer combinations that occur per second is equal to the difference in frequencies of the two notes.

10. 17.2 Hz

Given

$$L = 10.0 \text{ m}$$

$$v = 344 \text{ m/s}$$

Solution

For a pipe that is open at both ends,

$$f_n = n \frac{v}{2L}$$

At the fundamental frequency, $n = 1$, so

$$f_1 = 1 \left(\frac{v}{2L} \right) = \frac{344 \text{ m/s}}{2(10.0 \text{ m})} = 17.2 \text{ Hz}$$

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Section Quiz: Harmonics

Write the letter of the correct answer in the space provided.

- _____ 1. A vibrating air column in a cylindrical pipe open on both ends is capable of producing
- a. all frequencies.
 - b. only even-numbered harmonics.
 - c. only odd-numbered harmonics.
 - d. all harmonics.
- _____ 2. The lowest frequency of vibration of a plucked string is the string's _____ frequency.
- a. overtone
 - b. timbre
 - c. second harmonic
 - d. fundamental
- _____ 3. An air column in a pipe vibrates at a fundamental pitch of 680 Hz. If the length of the pipe were doubled, the fundamental pitch would be
- a. 170 Hz.
 - b. 340 Hz.
 - c. 1360 Hz.
 - d. 2720 Hz.
- _____ 4. How many nodes are present in a string vibrating at its fundamental frequency?
- a. 0
 - b. 1
 - c. 2
 - d. 3
- _____ 5. If the first harmonic of a vibrating string has a frequency of 812 Hz, the second and third harmonics will have frequencies of _____, respectively.
- a. 1218 Hz and 1624 Hz
 - b. 1218 Hz and 2030 Hz
 - c. 1624 Hz and 2436 Hz
 - d. 1624 Hz and 3248 Hz

Sound *continued*

- _____ 6. What length of guitar string would vibrate at a fundamental frequency of 1250 Hz if the string is stretched so that the velocity of waves on the string is 488 m/s?
- a. 19.5 cm
 - b. 39.0 cm
 - c. 1.28 cm
 - d. 256 cm
- _____ 7. A term for the quality of sound that gives each different musical instrument a unique sound is
- a. pitch.
 - b. overtone.
 - c. fundamental.
 - d. timbre.
- _____ 8. Two flute players are tuning their instruments. One player sounds a tone with a pitch of 527 Hz and the other player sounds a tone with a pitch of 523 Hz. How many beats per second will the players hear?
- a. none
 - b. 2
 - c. 4
 - d. 525

9. When two notes of slightly different frequencies are sounded, beats may be heard. Explain how these beats occur.

10. The longest common organ pipes are 32 feet (about 10 m) long. What is the fundamental frequency produced by an open-ended organ pipe that is 10.0 m in length? Assume that the pipe is in an environment where the speed of sound is 344 m/s.