ConcepTest 16.6a Pied Piper I

You have a long pipe and a short pipe. Which one has the higher frequency?

(1) the long pipe

(2) the short pipe

(3) both have the same frequency

(4) depends on the speed of sound in the pipe

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You have a long pipe and a short pipe. Which one has the higher frequency?

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(3) both have the same frequency

(4) depends on the speed of sound in the pipe

A shorter pipe means that the standing wave in the pipe would have a shorter wavelength. Since the wave speed remains the same, the frequency has to be higher in the short pipe.

ConcepTest 16.6b Pied Piper II

A wood whistle has a variable length. You just heard the tone from the whistle at maximum length. If the air column is made shorter by moving the end stop, what happens to the frequency?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

ConcepTest 16.6b Pied Piper II

A wood whistle has a variable length. You just heard the tone from the whistle at maximum length. If the air column is made shorter by moving the end stop, what happens to the frequency?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

A shorter pipe means that the standing wave in the pipe would have a shorter wavelength. Since the wave speed remains the same, and since we know that $v = f\lambda$, then we see that the frequency has to increase when the pipe is made shorter.

ConcepTest 16.6c Pied Piper III

If you blow across the opening of a partially filled soda bottle, you hear a tone. If you take a big sip of soda and then blow across the opening again, how will the frequency of the tone change?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

ConcepTest 16.6c Pied Piper III

If you blow across the opening of a partially filled soda bottle, you hear a tone. If you take a big sip of soda and then blow across the opening again, how will the frequency of the tone change?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

By drinking some of the soda, you have effectively increased the length of the air column in the bottle. A **longer pipe** means that the standing wave in the bottle would have a **longer wavelength**. Since the wave speed remains the same, and since we know that $v = f\lambda$, then we see that the **frequency has to be lower**.

Follow-up: Why doesn't the wave speed change?

ConcepTest 16.7 Open and Closed Pipes

You blow into an open pipe and produce a tone. What happens to the frequency of the tone if you close the end of the pipe and blow into it again?

1) depends on the speed of sound in the pipe
2) you hear the same frequency
3) you hear a higher frequency
4) you hear a lower frequency

ConcepTest 16.7 Open and Closed Pipes

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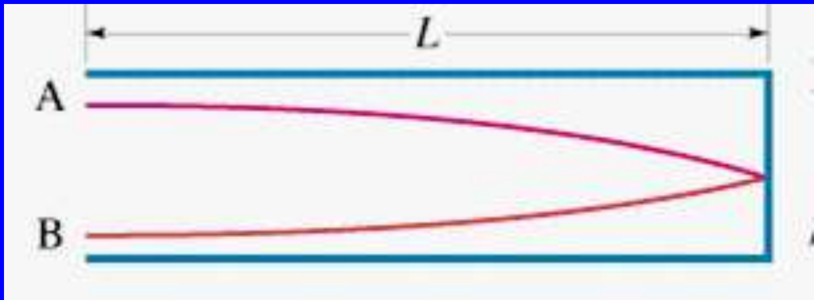
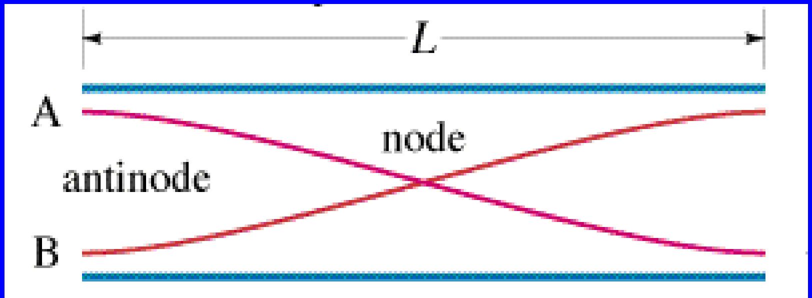
In the open pipe, 1/2 of a wave "fits" into the pipe, while in the closed pipe, only 1/4 of a wave fits. Because the wavelength is larger in the closed pipe, the frequency will be lower.





Follow-up: What would you have to do to the pipe to increase the frequency?

ConcepTest 16.8 Out of Tune

When you tune a guitar string, what physical characteristic of the string are you actually changing?

1) the tension in the string
2) the mass per unit length of the string
3) the composition of the string
4) the overall length of the string
5) the inertia of the string

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4) the overall length of the string
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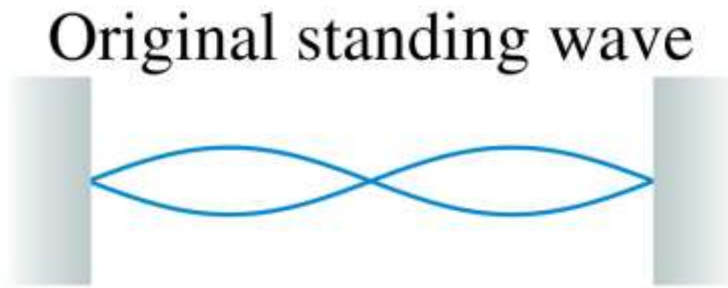
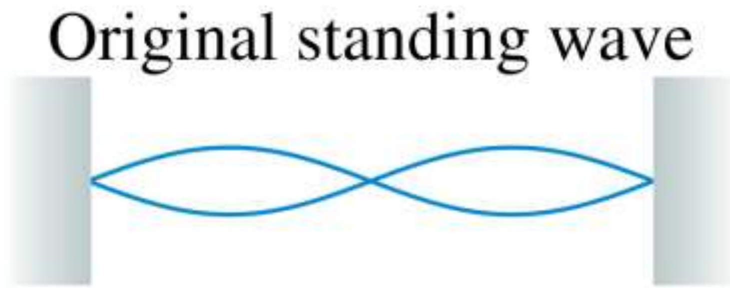
By tightening (or loosening) the knobs on the neck of the guitar, you are **changing the tension** in the string. This alters the wave speed and therefore alters the frequency of the fundamental standing wave because $f = v/2L$.

Follow-up: To increase frequency, do you tighten or loosen the strings?



A standing wave on a string vibrates as shown at the top. Suppose the tension is quadrupled while the frequency and the length of the string are held constant. Which standing wave pattern is produced?

(1) (2) (3) (4) (5)



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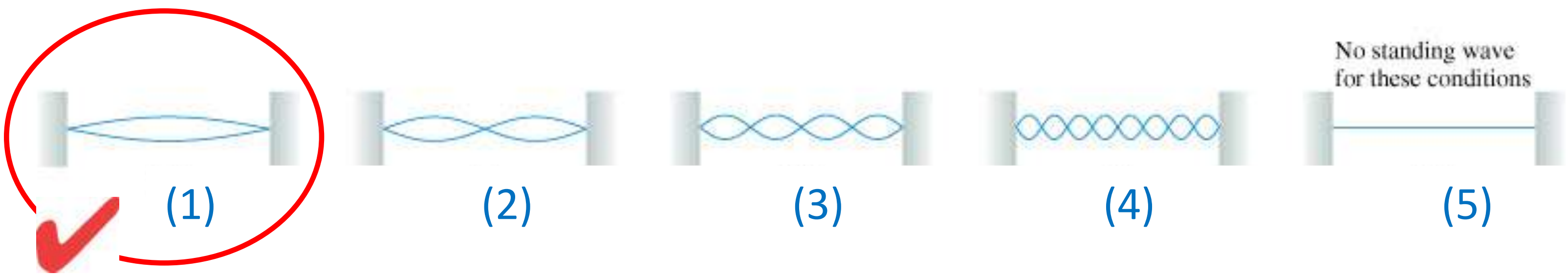

An open-open tube of air supports standing waves at frequencies of 300 Hz and 400 Hz, and at no frequencies between these two. The second harmonic of this tube has frequency

1. 800 Hz.
2. 600 Hz.
3. 400 Hz.
4. 200 Hz.
5. 100 Hz.

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