Waves: Standing or Not (Mostly Standing)

1. A student has a string and measures the speed of waves to be 16.05m/s in the string. The student also has a small motor that operates at 22.50Hz. What length of the string, fixed at both ends, will the student need in order to allow standing waves to set up at:

1. Third resonance
2. Fourth resonance
3. First resonance

2. A metal rod has a length of 1.20m. When the rod is fixed at one end and struck with a hammer, it produces a resonant sound at 72Hz. What is the speed of the waves in the rod?

3. First resonance in a 75cm guitar string is 125Hz.

1. What is the frequency of third resonance in the same length of string?
2. What length of string will find first resonance at 750Hz?

4. A boat sends a Sonar pulse (sound wave) to the bottom of a lake. The speed of sound in water is 1250m/s. The pulse returns to a detector on the boat in 0.365s. What is the depth of the lake?

5. A wave (not a standing wave) has an amplitude of 11.0cm. The wave travels at 7.1m/s and has a wavelength of 2.6m. Find the distance traveled by one point on the wave:

1. In one period.
2. In one second.
3. In 12s

6. A 24.0cm metal bar, fixed at one end, develops first resonance at 1440Hz. What length of the same bar will have first resonance of 680Hz?

7. A train has a whistle that blows at 1200.0Hz. How fast would the train need to travel for an observer to hear the sound as 1180.0Hz? Is the train approaching or receding?

8. How fast would an observer need to travel toward a stationary 440Hz sound source in order to perceive the sound as 460Hz?

9. What are the three lowest frequency sounds that will resonate in a 38.0cm long open tube at 40.0oC?

10. What is the wavelength of a light wave with ƒ=6.00x1012Hz traveling in glass with n=1.60?

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11. A closed pipe sets up first sound resonance at 360.0Hz at 10.0oC. What frequency of sound would set up first resonance in the same pipe at 40.0oC?

12. Draw a neatly labeled diagram of a horse wearing a cowboy hat on a pogo stick.

13. Which of the following has the highest frequency?

 a. Red Light

 b. Micro waves

 c. 94.7 MHz

 d. Infrared radiation

14. Explain how microwaves cook food.

15. A microwave oven creates burn patterns in marshmallows that are, on average, 9.0cm apart. What is the frequency of the microwave?

16. Describe one situation in which resonance would be of interest to a structural engineer designing a bridge.

17. A saxophonist tunes their saxophone (closed pipe) in Whitehorse at -40.0oC. They tune to a standard 440Hz. The saxophonist then travels to Santa Clara, Cuba and plays the saxophone at 37.0oC. What is the frequency of first resonance at this temperature?

18. What effect does increasing tension have on the speed of a wave in a string? What effect does increasing tension have on the natural frequency of a string?

19. A 1.0m length string has a natural frequency of 440Hz.

 a. Does an equal length string with higher linear mass density have a higher or lower natural frequency?

 b. Does a shorter piece of the same string have a higher or lower natural frequency?

 c. If the tension in the string is increased with the natural frequency be higher or lower?

20. A student conducts a resonance experiment with a variable length closed tube. The student has a small speaker connected to a source that generates a constant single tone. The student holds the speaker over the end of the tube and adjusts the length making note of the lengths that produce resonance. The tube starts at 1.00m in length. The student detects resonances at 97.8cm, 89.3cm, 80.8cm and then 72.3cm.

 What is the frequency of the source?

 Which resonance corresponds to each length?

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