

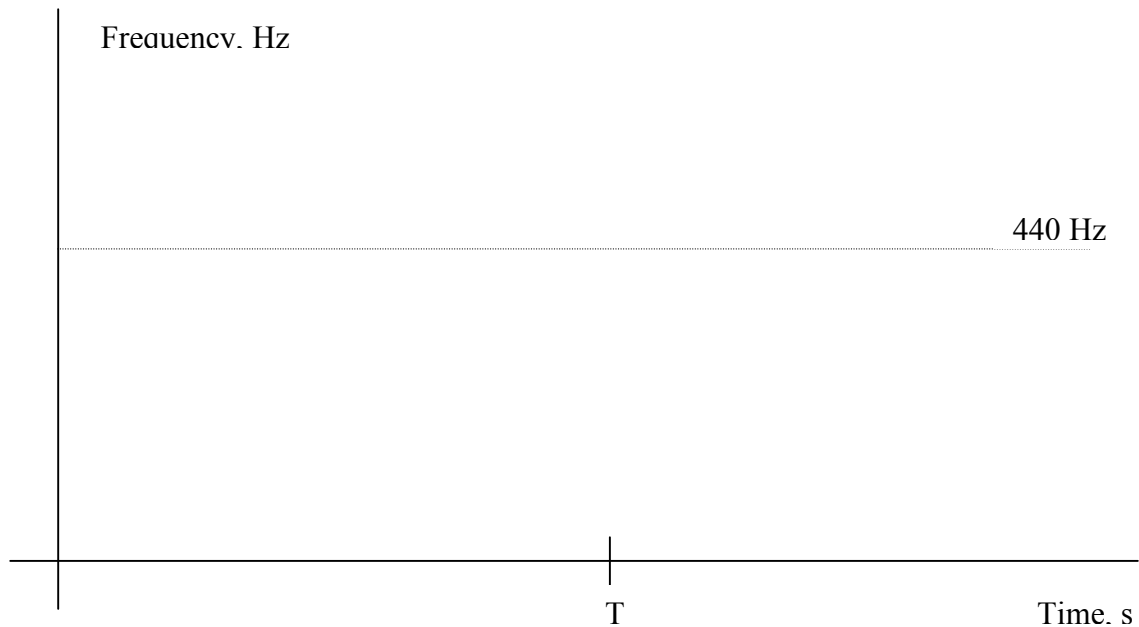
**9.03****Wave/Oscillator Problems**

$$v_{\text{sound}} = 340 \text{ m/s}$$

1. Use a ruler to draw a transverse wave moving along the line below with an amplitude of 2 cm (about 1 inch) and a wavelength of 1 cm (about  $\frac{1}{2}$  inch).
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2. What is the frequency of the wave in problem 1 if it takes 2 seconds to move along the given line?
  3. What is the wave's period in problem number 1?
  4. The frequency of the "E" string on a guitar undergoing its fundamental (first harmonic) vibration is 384 Hz.
    - a. Draw the shape of the standing wave on the string:
    - b. How many full waves are contained on the string (or what fraction of a full wave)?
    - c. If the length of the string is .8 meters, what is the speed of the wave on the string?
    - d. What is the wavelength of the resulting sound wave?
    - e. How many vibrations of the string take place while the sound travels 170 meters?

5. Explain how the  $v = f\lambda$  equation for waves relates to the  $s = vt$  equation for motion.
  
6. If I take a sound intensity measuring device to the center of Beaver Stadium (the football stadium for Penn State) and find that the sound of a screaming fan is measured at 30 dB, what intensity would result from the sound of all 100,000 fans screaming on game day?
  
7. The sound of your coach yelling to you from 5 feet measures 50 dB in intensity.
  - a. By what factor would the sound intensity diminish if you moved away to 50 feet?
  
  - b. What would the sound intensity measure at 50 feet in dB?
  
  - c. How far would you have to be away from your coach to reduce the sound intensity to 10 dB?
  
8. Police radar works by bouncing a wave of known frequency off of a moving car and measuring its frequency upon return.
  - a. What does it tell you about the car's position, velocity, and acceleration if the measured frequency is higher than the known frequency?
  
  - b. When a policeman pulls a driver over he says, "I can tell from my radar that you slowed down (decelerated) when you approached me." The driver goes to court claiming that since the Doppler Effect depends only on velocity, the policeman must be lying. Would she win or lose the argument in a fair court? Explain.

9. Draw a graph below of the frequency of a train whistle as the train passes you on its track while slowing down, stopping some time after going by. The actual frequency of the whistle is 440 Hz, and the train passes you at the time marked T.



10. Explain the three different ways you can make a guitar string play a higher frequency note, and explain why the note's frequency is higher in terms of how each way affects the string's wavelength and frequency.
11. Explain the two ways you can make a slide trombone play a different pitched note. Explain how each method you suggest affects the wavelength of the note.
12. What is the relationship between waves and oscillators? Which of their properties are the same, which are different?
13. What do waves accomplish in nature in terms of energy?

Answers to numerical problems:

2. About 6 Hz

3. About .17 second

4. b.  $\frac{1}{2}$

4. c. 614 m/s

4. d. 0.885 meters

6. 80 dB

7. a. 1/100

7. b. 30 dB

7. c. 500 feet