

Problems are from Tipler Chapter 15:

(1) **2** A traveling wave passes a point of observation. At this point, the time between successive crests is 0.2 s. Which of the following is true? a) The wavelength is 5 m b) The frequency is 5 Hz c) The velocity of propagation is 5 m/s d) The wavelength is 0.2 m e) There is not enough information to justify any of these statements.

(2) **7** If the source and receiver are at rest relative to each other but the wave medium is moving relative to them, will there be any Doppler shift in frequency?

(3) **9** Stars often occur in pairs revolving around their common center of mass. If one of the stars is a black hole, it is invisible (well, in visible light anyway). Explain how the existence of such a black hole might be inferred from the light from the other, visible star. (By the way, this same technique is how extra-solar planets have been discovered. They are too far away and too small to be found by directly seeing them.)

(4) **24** A steel wire 7 m long has a mass of 100 g. It is under a tension of 900 N. What is the speed of a transverse wave on this wire?

(5) **37** Show that the function  $y = A \sin kx \cos \omega t$  satisfies the wave equation. (Hint: plug in this function and take partial derivatives. Show that you get  $v = \omega/k$ .)

(6) **43** The wave function for a harmonic wave on a string is:  $y(x, t) = (0.001 \text{ m}) \sin(62.8 \text{ m}^{-1}x + 314 \text{ s}^{-1}t)$   
(a) In what direction does this wave travel and what is its speed? (b) Find the wavelength, frequency, and period of this wave (c) What is the maximum speed of any string segment?

(7) **50** Middle C on the musical scale has a frequency of 262 Hz. (a) What is the wavelength of this note in air? (b) The frequency of the C an octave above middle C is twice that of middle C. What is the wavelength of this note in air?

(8) **69** Three noise sources produce intensity levels of 70, 73 and 80 dB when acting separately. When the sources act together, their intensities add. (a) Find the sound intensity level in decibels when the three sources act at the same time (b) Discuss the effectiveness of eliminating the two least intense sources in reducing the intensity level of the noise

(9) **77** The source emits frequency 200 Hz, which travels through still air at 340 m/s. The listener moves at 80 m/s relative to still air toward the stationary source. (a) What is the wavelength of the sound between the source and the listener? (b) What is the frequency heard by the listener?

(10) **94** A car is approaching a reflecting wall. A stationary observer behind the car hears a sound of frequency 745 Hz from the car horn and a sound of frequency 863 Hz from the wall. (a) How fast is the car traveling? (b) What is the frequency of the car horn? (c) What frequency does the car driver hear reflected from the wall?