HW#12 Solutions, Physics 107

Gladden, Fall 2006
(not to be turned in)

Solutions to Chapter 19 Exercises

4. A shorter pendulum swings to and fro with a higher frequency and shorter period.

8. The period increases, for period and frequency are reciprocals of each other.

9. Lower frequency produces waves farther apart, so wavelength increases. Wavelength and frequency are inverse to each other.

16. To produce a transverse wave with a Slinky, shake it to and fro in a direction that is perpendicular to the length of the Slinky itself (as with the garden hose in the previous exercise). To produce a longitudinal wave, shake it to-and-fro along the direction of its length, so that a series of compressions and rarefactions is produced.

20. No, for wave speed involves the rate of travel while wave frequency involves how frequently vibration occurs.

34. They are higher frequency due to the Doppler effect.

39. Police use radar waves which are reflected from moving cars. From the shift in the returned frequencies, the speed of the reflectors (car bodies) is determined.

Solutions to Chapter 20 Exercises

7. The carrier frequency of electromagnetic waves emitted by the radio station is 101.1 MHz.

9. The wavelength of the electromagnetic wave will be much longer because of its greater speed. You can see this from the equation speed = wavelength $\times$ frequency, so for the same frequency greater speed means greater wavelength. Or you can think of the fact that in the time of one period—the same for both waves—each wave moves a distance equal to one wavelength, which will be greater for the faster wave.

11. Light travels about a million times faster than sound in air, so you see a distant event a million times sooner than you hear it.

16. The fact that we can see a ringing bell but can't hear it indicates that light is a distinctly different phenomenon than sound. When we see the vibrations of the "ringing" bell in a vacuum, we know that light can pass through a vacuum. The fact that we can't hear the bell indicates that sound does not pass through a vacuum. Sound needs a material medium for its transmission; light does not.

19. If the speed of sound were different for different frequencies, say, faster for higher frequencies, then the farther a listener is from the music source, the more jumbled the sound would be. In that case, higher-frequency notes would reach the ear of the listener first. The fact that this jumbling doesn't occur is evidence that sound of all frequencies travel at the same speed. (Be glad this is so, particularly if you sit far from the stage, or if you like outdoor concerts.)

29. First, in outer space there is no air or other material to carry sound. Second, if there were, the faster-moving light would reach you before the sound.