Homework 2

Chapters 14 and 24

Problem 1. *A string with a mass of* 5 *g and a length of* 1 *m has one end attached to a wall.* 70 *cm from the wall, the string passes over a pully and hangs, supporting a* 1 *kg mass. (a) What is the fundamental frequency of vibration? (b) What is the frequency of second harmonic?*

Problem 2. *A student uses an audio oscillator of adjustable frequency to measure the depth of the well. The student hears two successive resonances at* 122.0 *Hz and* 127.1 *Hz. How deep is the well?*

Problem 3. *Set-top loop antennas are sometimes used to pick up UHF TV broadcast with a carrier frequency f and peak electric field at the antenna of E_{max}. The changing magnetic flux in the antenna loop produces an emf which matches the broadcast signal. (a) Using Faraday's law, derive an expression for the amplitude of the emf in a single-turn circular loop of radius r, if r is much less than the broadcast wavelength. (b) If the TV station is due East of your house and the electric field oscillates vertically, how would you orient the antenna for best reception?*

Problem 4. *(a) Caluculate the inductance of an LC circuit that oscillates at* 60 *Hz when the capacitance is* 5.00 μF. *(b) A resistor is inserted into the LC loop shown in Figure 24.8. Give a qualitative description of current oscillation in the new circuit.*

Problem 5. *You're listening to WKDU (transmitted from Van Rensselaer Hall) on 91.7fm while watching a basketball game* 400 *m away at the DAC. How many wavelengths are between you and the transmitter? FM channel names give the carrier frequency in MHz.*

Problem 6. BONUS PROBLEM. *Two identical speakers $d = 10.0$ m apart are driven by the same oscillator with a frequency of $f = 21.5$ Hz. (a) Explain why a reciever at point A records a minimum in sound intensity from the two speakers. (b) If the reciever is moved in the plane of the speakers, what path should it take so that the intensity remains at a minimum? That is, determine the relationship between x and y (the coordinates of the reciever) that causes the receiver to record a minimum in sound intensity. Take the speed of sound to be $v = 344$ m/s.*