Chapter 15 Written Homework Problems
DUE: April 21st at the beginning of class
SHOW ALL WORK FOR FULL CREDIT

1. The displacement of a wave is given by $y = 2.1\cos(0.32x + 0.52t)$. What is the waves *(a)* amplitude, *(b)* wavelength, *(c)* period, *(d)* speed, and *(e)* direction of propagation? Take x measured in cm and t in seconds.

2. On a spring of mass m and length L_1 transverse waves propagate at a speed v_1. When the spring is stretched further to a length L_2 the waves propagate at a speed v_2. What is the spring constant of the spring in terms of these variables?

3. The standard for tuning orchestral instruments uses the frequency of the note A above middle C which is 440 Hz. A steel piano wire that is 38.9-cm long and has a mass of 3.00 g is tuned to its fundamental frequency of 440 Hz. *(a)* What is the tension in the wire? *(b)* What is the highest harmonic that could be heard by a person who is capable of hearing frequencies up to 20 kHz? *(c)* What percentage change in tension would be required to raise the fundamental frequency from A above middle C to B-flat above middle C (B-flat ~466 Hz)?

4. For the piano wire in problem 3, assumed now to be tuned to A above middle C, what is the maximum power that can be transmitted on such a wire if the wave amplitude is not to exceed 1% of the wavelength?

5. A source emits 0.1 W of spherical waves into a uniform perfectly transmitting medium. What is the wave intensity 1 meter from the source?

6. A uniform cable of length L is hung from horizontal beam. *(a)* Find the speed of waves on the cable as a function of the distance from the bottom of the cable, y. *(b)* How long does it take waves to propagate up the cable in terms of L? Suppose the cable is 5.0m in length and weighs 50 N. *(c)* What is the speed of transverse waves at a distance $L/3$ and a distance $2L/3$ from the bottom of the cable? (d) How do the relative wave speeds in these locations compare to the relative tensions in the cable in these locations? Explain.