Ph202H/212H
W09 Homework – due February 16, 2009

1. A string fixed at both ends is 8.36 m long and has a mass of 122 g. It is subject to a tension of 96.7 N and set vibrating. (a) What is the speed of waves in the string? (b) What is the wavelength of the longest possible standing wave? (c) What is the frequency of that wave?

Answer: (c) 4.87 Hz

2. The equation of a transverse wave on a string is $y(x,t) = (0.15\text{ m})\sin(0.79x - 13t)$ where x is in meters and t is in seconds. (a) What is the displacement at x = 2.3 m, t = 0.16 s? (b) Write down the equation of a wave which, when added to the given wave, would produce standing waves on the string. (c) What is the displacement of the resulting standing wave at x = 2.3 m, t = 0.16 s?

Answer: (c) –0.14 m

3. A string is attached between fixed supports separated by 0.750 m. It is observed to have resonant frequencies of 420 and 315 Hz with no other resonant frequencies between those two values. (a) What is the lowest resonant frequency of the string? (b) What is the wave speed on the string?

Answer: (b) 158 m/s

4. Two waves are propagating on the same very long string. A generator at one end creates a wave given by

$$y(x,t) = (6.0\text{ cm})\cos\frac{\pi}{2}(2x + 8t)$$

and a generator at the opposite end creates the wave

$$y(x,t) = (6.0\text{ cm})\cos\frac{\pi}{2}(2x - 8t)$$

with x in meters and t in seconds. (a) Calculate the frequency, wavelength, and speed of each wave. (b) Find the points on the string where the combined wave produces no motion. NOTE: You can check this numerically or graphically if you want to, but you first need to solve it analytically by combining trig functions as is done in the text. (c) At which points does the string oscillate with the largest amplitude?

Answer: (c) x = 0, 1.0 m, 2.0 m, 3.0 m, etc.