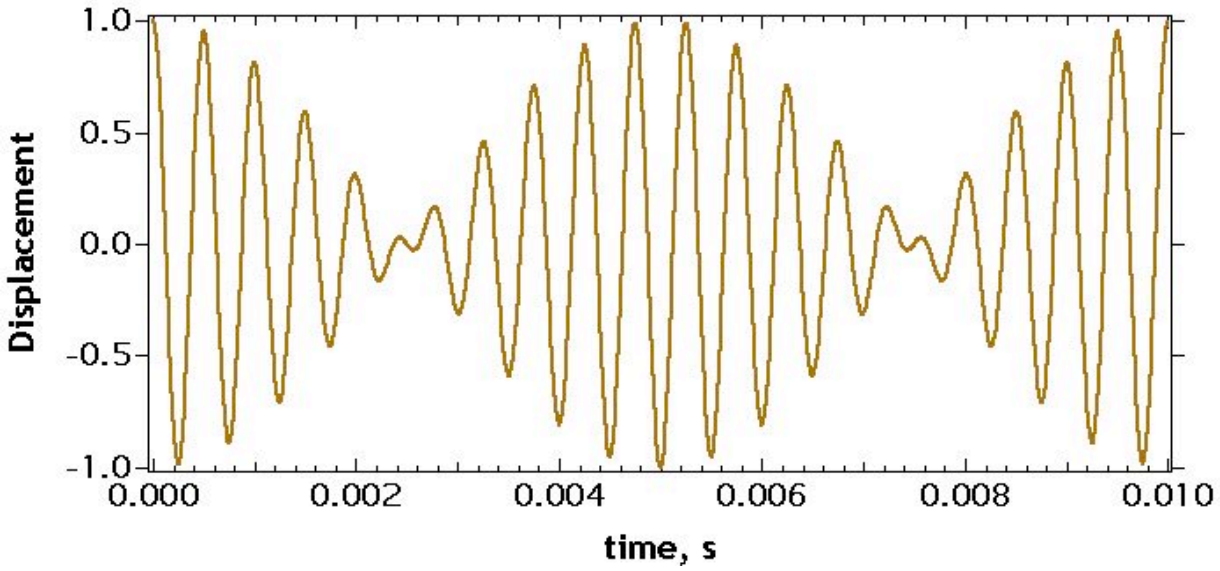
**Physics 273, Fall 2006**
**Exam # 1** **Name** _____

Closed-book examination. One pre-prepared 8 ½" x 11" sheet of notes may be used. Calculator may be used. Show work for partial credit. Include UNITS on all answers.

EXAM ADVICE: If you don't immediately see what to do on one problem, go on to the next problem and come back to the unfinished problems later.

**(30 points) 1.** Determine as <u>quantitatively</u> as possible the periods present in the sum wave shown, and use the estimates to find the frequencies, $f_1$ and $f_2$, of the two cosine waves that were summed to produce the wave.



(**35 points)** 2. Consider a series RL circuit with a resistor R and an inductor L driven by an AC source of voltage $V_o\cos(\omega t)$. You must show the reasoning and derivations completely and clearly to obtain credit. *Continue work on the blank sheet following this page if needed.*

a) Draw the circuit and write the equation for the voltage drop across each component. What is the differential equation describing I(t), the current in the circuit?

b) Rewrite the differential equation from part a) using imaginary voltage and current functions, $\hat{I}$ and $\hat{V}$, such that V = Re($\hat{V}$) and I = Re($\hat{I}$), and $\hat{V} = V_o e^{i\omega t}$, $\hat{I} = \hat{I}_o e^{i\omega t}$. Solve for $\hat{I}_o$ and take the real part to find I. Give the expression for the phase difference between the current and the AC voltage source.

c) Write expressions for the voltage drop across the resistor and the inductor. Given $\omega$ =130 kHz, L = 0.50 H, $V_o$ = 12 V, and R = 65kΩ, find the phase shift of the voltage drop across the resistor, and find the phase shift of the voltage drop across the inductor.

(**35 points**) 3. A transverse sinusoidal wave on a taut wire has an amplitude of 2 mm and a wavelength of 1.22 m. The wave speed is 180 m/s. The wave is traveling in the positive x direction, and the displacement is in the y direction. *Continue your work on the blank sheet following this one if needed.*

a) Write the function y(x,t) describing the motion of the wave assuming that the displacement is y = 1mm at x=0 and t=0. Give numerical values with units for all the parameters in y(x,t). Find the value of the tension in the wire given a linear density of $2.45 \times 10^{-2}$ kg/m.

b) Find the maximum vertical speed of the wire. Consider the position x = 2.0 m and find the first time after t=0 at which the vertical speed of the wire is zero.

c) Find the value of the maximum energy per unit length at any one position along the string. Carefully draw a graph of the displacement vs. time and the energy vs. time at x = 0.0 m. Label your axes quantitatively.