Name:

Math Questions - Partial credit will be given. If you can't find the number, give the method. If you don't know the method, give your thoughts. (Note: Be sure to answer everything asked.)

1. (14 pts) Make a linear superposition of square-wave motion and simple harmonic (sine-wave) motion with half the amplitude and twice the frequency of the square wave. This can be done by making a graph of each waveform to scale and then adding the oridnates point by point. (Alternatively, of course, it could be done by computation.)

2. (14 pts) Pure tones with frequencies of 440 and 448 Hz are sounded together. Describe what is heard (pitch of the fused tone, frequency of beats). Do the same for tones with frequencies of 440 and 432 Hz.

3. (14 pts) Calculate the first three difference frequencies that result from $f_1 = 900$ Hz and $f_2 = 1000$ Hz.

4. (14 pts) A particular octave-band sound analyzer measures the sound level in ten octave bands with center frequencies as given below. What are the closest notes on the musical scale to these center frequencies?

   31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, 16000 Hz

5. (16 pts) A 65 cm guitar string is plucked at 21.67 cm from the nut. If all of the modes of vibration begin "in phase", then draw the displacement of the string as the linear superposition of the first three modes of vibration at time = 0 sec.

6. (14 pts) An electric guitar pickup is placed 16.25 cm from the bridge. If the string length is a standard 65 cm, which harmonics won't be "picked up" by this pickup? Draw an example spectrum with at least 10 partials.

7. (14 pts) What are the five frequency ratios between the consecutive strings on a guitar? What musical intervals to they represent?