Chapter 18 Homework Problems

1. In pipe A, the ratio of a particular harmonic frequency to the next lower harmonic frequency is 1.4:1. In pipe B, the ratio of a particular harmonic frequency to the next lower harmonic frequency is 1.3333:1.
   a) How many open ends does pipe A have?
   b) How many open ends does pipe B have?

2. A violin string is 50.0 cm long and has a linear mass density of 0.750 g/m. The string is placed near a loudspeaker that is fed by an audio oscillator of variable frequency. The oscillator frequency is varied continuously from 500 Hz to 1500 Hz, and it is found that the string is set into oscillation only at the frequencies 880 Hz and 1320 Hz. What is the tension in the string?

3. Organ pipe A, with both ends open, has a fundamental frequency of 240 Hz. The third harmonic of organ pipe B, with one end open, resonates with (has the same frequency as) the second harmonic of organ pipe A. What are the lengths of organ pipe A and organ pipe B?

4. The figure below shows four tubes. Tubes A and B each have lengths of 0.8 m, while tubes C and D each have lengths of 1.6 m. Tubes A and C are open at one end and closed at the other end, while tubes B and D are open at both ends. The third harmonic is set up in each tube. Detector O is moving directly away from the 4 tubes with speed \( v_0 \). For this problem, leave your answer in terms of the speed of sound in the medium. (Hint: Due to its motion, the detector will detect a Doppler shifted frequency.)
   a) What speed must the detector have in order to detect the fundamental frequency in tube A?
   b) What speed must the detector have in order to detect the fundamental frequency in tube B?
   c) What speed must the detector have in order to detect the fundamental frequency in tube C?
   d) What speed must the detector have in order to detect the fundamental frequency in tube D?

5. Two identical piano wires have a fundamental frequency of 440 Hz when kept under the same tension. What fractional increase in the tension of one wire will lead to the occurrence of 4 beats/s when both wires oscillate simultaneously?

Problems are due at the beginning of class on Wednesday, March 2!