Name: _____

Other group members: _____

Tutorial #7

PHYS 1240: Sound and Music

Friday, July 26, 2019

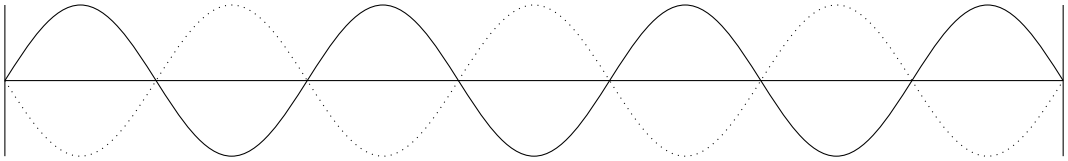
Instructions: Work in groups of 3 or 4 to answer the following questions. Write your solutions on this copy of the tutorial—each person should have their own copy, but make sure you agree on everything as a group. When you're finished, keep this copy of your tutorial for reference—no need to turn it in (grades are based on participation, not accuracy).

1. A string is 0.60 m long from nut to bridge and has a tension of 36.0 N (N="newtons" – for reference, 1 N is about the weight of an apple). The mass per unit length of the string is 0.015 kg/m.

   (a) What is the frequency of the third harmonic?

   (b) What happens to the frequency of the third harmonic if the mass per unit length is reduced by a factor of two?

2. The total length of this string is 2.0 m. What is the wavelength of this natural mode, and which harmonic is it?



3. An oboe can be modelled as a cone open at one end. What might a harmonic series be for the oboe (in Hz)?

   (a) 121, 233, 251, ...

   (b) 120, 240, 360, ...

   (c) 120, 360, 600, ...

   (d) None of the above

4. A frequency spectrum from an unknown instrument shows large peaks at frequencies of 440, 1320, and 2200 Hz. What could this instrument be?

   (a) bassoon

   (b) clarinet

   (c) flute

   (d) French horn

   (e) multiple of these

5. A clarinet has a length of 1 m. What is the frequency of the instrument's third harmonic?

   (a) 343 Hz

   (b) 172 Hz

   (c) 257 Hz

   (d) 515 Hz

   (e) None of the above

6. A saxophone plays a note at 220 Hz with the octave key hole closed. What would be the frequency of the note when the octave key hole is opened?

   (a) 220 Hz

   (b) 440 Hz

   (c) 660 Hz

   (d) None of the above

7. Consider a clarinet fingered to sound a B_3 at 246.9 Hz in its low register. What frequency would you expect to get by pressing the register key (or opening the register hole) with the same fingering?

8. Identifying musical instruments: Draw lines to associate each instrument with the best physical approximation.

Oboe	cylinder open at both ends
Clarinet	cylinder closed at both ends
Saxophone	cylinder closed at one end
Recorder	cone closed at both ends
Bassoon	pipe with open bell at one end
Flute	circular vibrating membrane
Trumpet	cone open at one end

9. The ear canal leading to the ear drum is roughly 2.5 cm long, open at the outer end and closed by the eardrum on the other end. If we model this as a cylindrical tube, what are the frequencies of the first and second natural modes? How can you relate this to the Equal-Loudness Contour plot shown below?