Physics 101: The Science of Sound
MiniTest 6a, 12/7/05

Name _____

For questions with numerical answers, draw a box around your final answer.

Except as noted, correct answers get full credit. Incorrect answers get partial credit based on the work shown.

If any problem relies on a previous answer, scoring on that problem will be based on YOUR previous answer, whether or not it is correct.

Scoring:

Raw Total: _____/100 pts

Adjusted Score: _____%

Potentially useful equations

$$\Delta x = A\cos(\phi)$$

$$\Delta x = A\cos\left(\frac{360^\circ}{T}t + \phi_0\right)$$

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

$$PE = \frac{1}{2}k(\Delta x)^2$$

$$KE = \frac{1}{2}mv^2$$

$$L_I = (10\text{ dB})\log\left(\frac{I}{I_0}\right)$$

$$I = I_0\,10^{(L_I/10\text{ dB})}$$

$$\Delta L_I = L_{I1} - L_{I2} = (10\text{ dB})\log\left(\frac{I_1}{I_2}\right)$$

$$\frac{I_1}{I_2} = 10^{(\Delta L_I/10\text{ dB})}$$

$$A = \pi r^2$$

$$A = 4\pi r^2$$

$$g[\text{dB}] = (10\text{ dB})\log\left(\frac{W_{out}}{W_{in}}\right) = (10\text{ dB})\log(g)$$

$$L_W = (10\text{ dB})\log\left(\frac{W}{W_0}\right)$$

$$L_{W,out} = L_{W,in} + g[\text{dB}]$$

$$v = \sqrt{\frac{F_T}{\mu}}$$

$$I = \frac{\Delta p^2}{400\text{ kg/m}^2\text{s}}$$

$$\Delta\phi_w = \Delta\phi_s - d\,\frac{360^\circ}{\lambda}$$

$$d_2 - d_1 = n\lambda$$

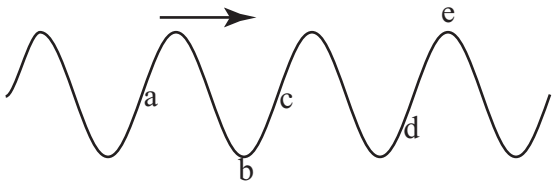
$$f_n = n\,\frac{v}{2L}$$

$$f_m = m\,\frac{v}{4L}$$

acceleration due to gravity = 9.81 m/s^2

semitone ratio = 1.05946

1) [10 pts] The picture to the right is a snapshot of a traveling wave on a string. Which of the labeled positions on the string have the most potential energy?



(A) a & c (B) c only (C) b & e

(D) e only (E) d only (F) b & c

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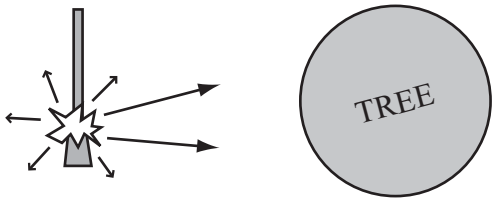
2) [10 pts] A hunting riffle is fired near a large birch tree, as illustrated in a birds-eye view to the right. The sound actually eminates from the chamber, near the handle. For the two lines of propagation indicated by the larger arrowheads ***only***, draw the path that the sound will follow as it interacts with the tree. (Assume the birch bark is smooth, a nice sound reflector. **If you draw any lines other than the lines of propagation, make them dotted or dashed.**)



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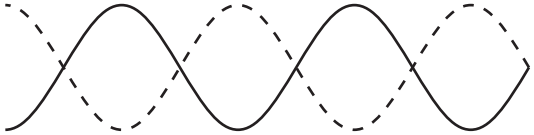
3) [10 pts] A standing pressure wave in a tube is represented to the right. Label *all* nodes with N, *all* antinodes with A, one loop and one wavelength.



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4) [10 pts] For the tube in question 3, which harmonic mode is illustrated (circle all that apply)?

(A) $4^1/_2$th (B) $2^1/_4$th (C) 5th (D) 1st

(E) 9th (F) 4th (G) 3rd (H) That is not a harmonic mode.

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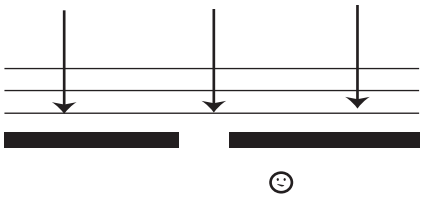
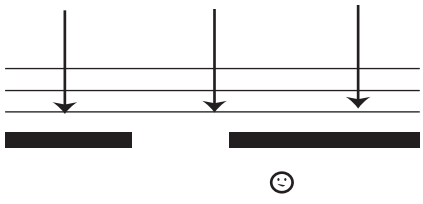
5) [10 pts] The pictures below show plane waves of sound approaching a hole in a wall. An observer is standing to the right of the opening, in all cases in the same place relative to the right side of the opening. All incident waves would have the same loudness for someone in front of the wall. In which situation will the observer hear the loudest sound? (Circle letter)

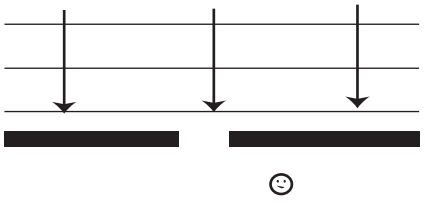
(A)



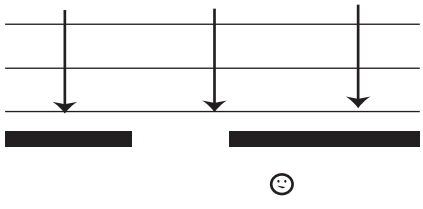
(B)



(C)



(D)



6) [10 pts] Concerning the stereo effect while using head phones, choose the elements to form a correct statement:

"We wish to make a sound appear to come from right of center. For any frequency above …

(A) 500Hz (B) 1000Hz (C) 2000Hz (D) 4000Hz

… this can be achieved by presenting the right ear with a signal that is …

(E) louder than (F) delayed in phase compared to

(G) softer than (H) advanced in phase compared to

… the signal to the left ear."

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7) [20 pts] Two speakers and you are arranged on a straight line, with the speakers separated by 0.45m, and you 1.3m from the closest speaker. The speakers are being driven by the same electronic source, but one has been wired backwards so that they are exactly out of phase with each other. Give two frequencies for which the sound you hear from the speakers will be particularly reduced in loudness. HINT: Partial credit given for a clear picture illustrating the wave relationships.

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8) [20 pts] One of the strings in a grand piano is 0.9m long and has a total mass of 3.5g (when detached from piano, of course!). It is tuned by stretching it with a force of 86N. What frequency will the note be when it is played.