Unit: Oscillations and Waves

I. Oscillatory Motion: Amplitude, Frequency, and Velocity
   a) Mass on a spring
   b) Pendulums

II. Traveling Waves
   a) Types and properties
   b) Frequency, Velocity, and Wavelength

III. Sound
   a) Intensity vs. distance
   b) Doppler effect

IV. Superposition
   a) Addition of Waves
   b) Standing Waves (strings and pipes)
   c) Beats
\[ r_2 - r_1 = 0 \]
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\[ r_2 - r_1 = n\lambda \quad n = 0,1,2,3... \]
\[ r_2 - r_1 = n(\lambda/2) \quad n = 1,3,5,7,\ldots \]
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Two speakers, placed 10m apart, emit frequencies of 550Hz. The diaphragms of the speakers are in phase with each other. If you start at one speaker and walk toward the other one, how far apart are the positions of silence?
Two speakers sit 6m apart. The speakers are in phase and play the same frequency of 30Hz. We know that there will be a max volume exactly between them (3m from each). What is the position of the next max volume (closest to the middle)?
Two strings on a musical instrument are required to emit different tones, the frequency of string a to be greater than that of string b. This condition might be secured by making:

a) a longer than b  
b) a thicker than b  
c) the tension of b greater than that of a  
d) a shorter than b
Which one of the following will result in *standing waves*?

A) the superposition of waves that travel with different speeds
B) the superposition of identical waves that travel in the same direction
C) the superposition of identical waves that travel in opposite directions
D) the superposition of nearly identical waves of slightly different amplitudes
E) the superposition of nearly identical waves of slightly different frequencies
A standing wave is produced on a string. If I double the tension, what must I do to the frequency to produce the same standing wave?
A stretched string 1m long vibrated with a fundamental frequency of 200Hz. The speed of a transverse wave on this string was
a) 100m/s
b) 200m/s
c) 400m/s
d) 800m/s
e) 662 m/s
What happens to the frequency of an organ pipe if you saw off a bit of the end of the pipe?
A pipe closed at one end and open at other will give

a. All even harmonics
b. All odd harmonics
c. All the harmonics
d. None of the harmonics
The figures show standing waves of sound in six organ pipes of the same length. Each pipe has one end open and the other end closed. Note: some of the figures show situations that are not possible.

Which one of the pipes emits sound with the lowest frequency?
The figures show standing waves of sound in six organ pipes of the same length. Each pipe has one end open and the other end closed. Note: some of the figures show situations that are not possible.

Which one of the pipes emits sound with the highest frequency?
The figures show standing waves of sound in six organ pipes of the same length. Each pipe has one end open and the other end closed. Note: some of the figures show situations that are not possible.

Which one of the pipes is resonating in its third harmonic?
Which standing waves could be formed on an organ pipe with both ends open (or a string with both ends free)?

(a)  
(d)  
(b)  
(e)  
(c)  
(f)
Which of the standing waves shown creates a sound with the highest frequency?

(a)  
(b)  
(c)  
(d)  
(e)  
(f)
If the standing wave shown in f has the frequency 768 Hz, what is the frequency of the standing wave shown in a?
You are walking down a 25m long hallway that is open on one end when the town fire alarm goes off. You notice a “dead spot” about every 2.33m. What is the frequency of the fire alarm?
You are walking down a 25m long hallway that is open on one end when the town fire alarm goes off. You notice a “dead spot” about every 2.5m. What harmonic is set up in the hallway.
A sound wave in a 2m long tube of mercury has a frequency of 100,000Hz. The reflected waves combine with the initial waves to form standing waves with nodes 7.07mm apart. What is the speed of sound in mercury?

a) 0.707x10^5 cm/s
b) 1.41x10^6 cm/s
c) 1.41x10^5 cm/s
d) 3.3x10^4 cm/s
As the frequencies of two waves get closer together, what happens to the beat frequency?
Which one of the following superpositions will result in beats?
A) the superposition of waves that travel with different speeds
B) the superposition of identical waves that travel in the same direction
C) the superposition of identical waves that travel in opposite directions
D) the superposition of waves that are identical except for slightly different amplitudes.
E) the superposition of waves that are identical except for slightly different frequencies.
Two strings produce frequencies of 300Hz and 305Hz.

What frequency results?
Two strings produce frequencies of 300Hz and 305Hz.

What is the beat frequency?
Two strings produce frequencies of 300Hz and 305Hz.

What happens to the beat frequency if the string producing 305Hz is tightened?
Two pipes produce frequencies of 300Hz and 305Hz.

What happens to the beat frequency if the pipe producing 305Hz is shortened?
You are attempting to tune the A-string on your piano by matching it to a 440Hz pitch fork. You notice that the piano sounds flat and you hear 5 beats/sec. To what fraction of the present tension should you adjust the string?