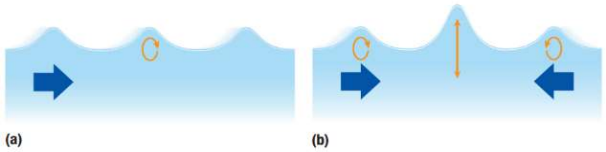
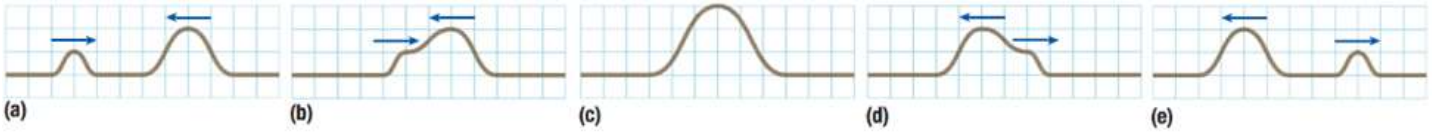
SPH3U 9.1 Interference of Waves

1. Wave interference

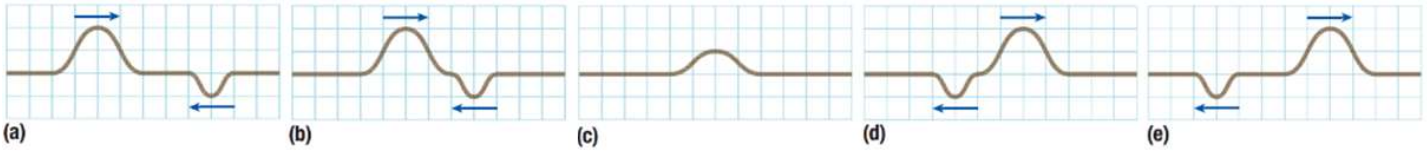
Interference:	



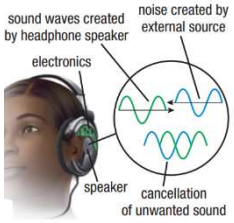
Principle of superposition:	
Constructive interference:	



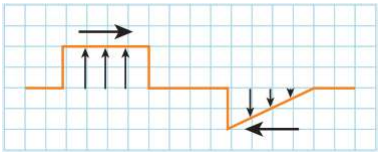
Destructive interference:	



Noise-cancelling headphones:	
benefit	



These two waveforms are about to interfere with each other. Draw the resultant waveform.



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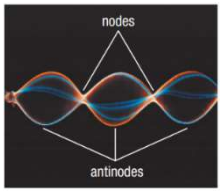
SPH3U 9.2 Waves at Media Boundaries

2. Standing waves



Standing wave:	
cause	
nodes	
antinodes	

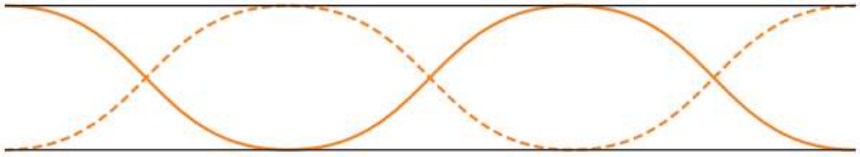
3. Standing waves – 2 fixed ends

Fixed end:	
2 fixed ends	

Symbol	Number of nodes between ends	Diagram	Harmonic (n)	Overtone
f_0	0	antinode; f_0; $n = 1$; $L_1 = \frac{1}{2}\lambda$	first	fundamental
f_1	1	node; f_1; $n = 2$; antinode; $L_2 = \lambda$	second	first
f_2	2	node; node; f_2; $n = 3$; antinode; $L_3 = \frac{3}{2}\lambda$	third	second
f_3	3	node; node; node; f_3; $n = 4$; antinode; $L_4 = 2\lambda$	fourth	third

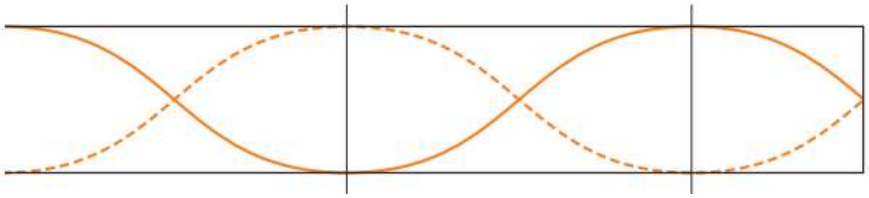
4. Standing waves – 2 free ends

Free end:	
2 free ends	



5. Standing waves – fixed-free ends

Fixed-free ends:	



6. Equations

2 fixed or 2 free:	
Fixed-free:	

The speed of a wave on a string with a fixed end and a free end is 350 m/s. The frequency of the wave is 200.0 Hz. What length of string is necessary to produce a standing wave with the first harmonic?

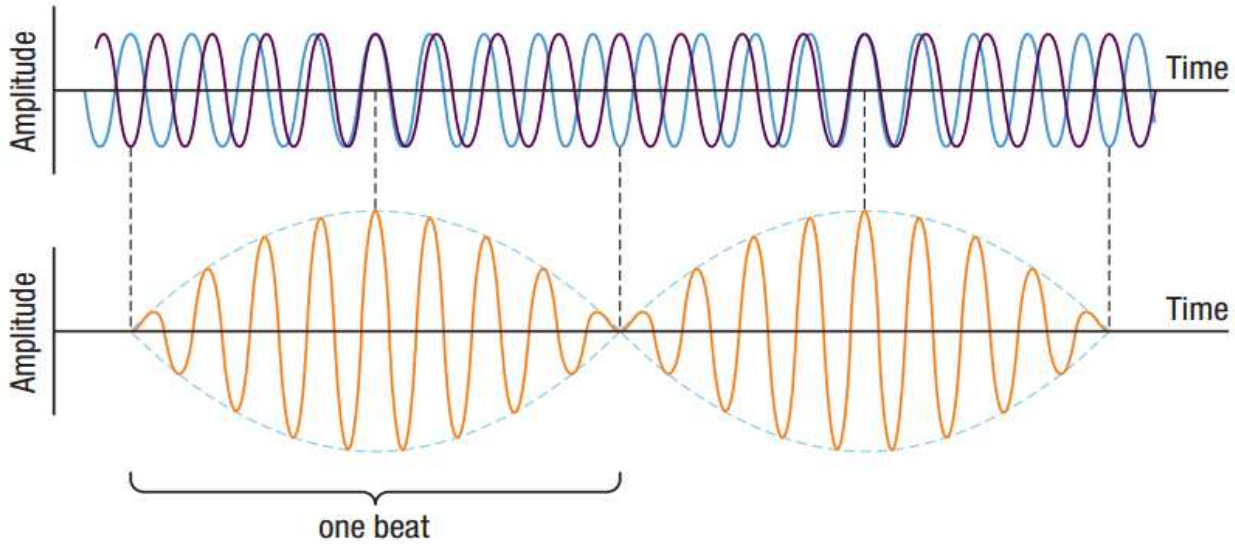
The sixth harmonic of a 65 cm guitar string is heard. If the speed of sound in the string is 206 m/s, what is the frequency of the standing wave?

Homework: page 426: #5-7

SPH3U 9.3 Beats

7. Beats

Beat:	
Beat frequency:	
equation	



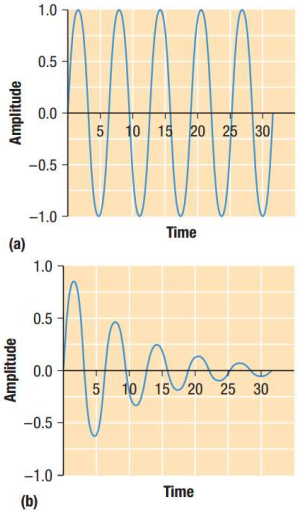
John is tuning his guitar. His string produces a frequency of 442 Hz, and his tuner produces a frequency of 440 Hz. What beat frequency does John hear?

Homework: page 429: #2-3

SPH3U 9.4 Damping and Resonance

8. Damping and resonance

Damping:	
Resonant frequency:	
resonance	
standing waves	
Vibrating structures:	



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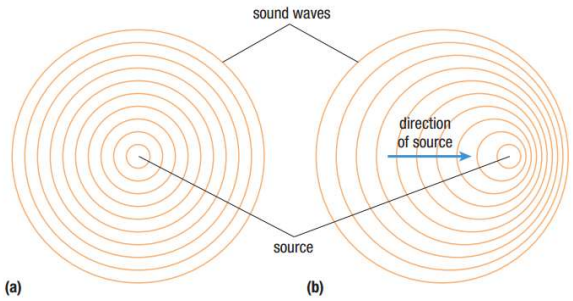
SPH3U 9.5 The Doppler Effect

9. The Doppler Effect

The Doppler Effect:	
equation	
v_{source}	



Suppose a fire truck is moving toward a stationary observer at 25.0 m/s. The frequency of the siren on the fire truck is 800.0 Hz. Calculate (a) the frequency detected by the observer as the fire truck approaches and (b) the frequency detected by the observer after the truck passes by. The speed of sound in this case is 342 m/s.

Homework: page 435: #4-5