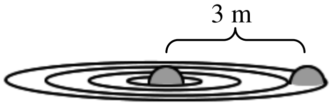
Due Tues., April 10

2011-12 PreAP Harmonic Motion 13



1. Two beach balls are floating in water with a separation distance of 3 m. When the first ball is pushed down 5 cm into the water it vibrates up and down 6 times per second. The second ball starts to bounce 0.2 seconds later.
   - A. What is the amplitude of the first ball?
   - B. Calculate the speed of the wave.
   - C. Calculate the wavelength of the wave.

2. Longitudinal or Transverse wave?

A. ___ A standing wave on a string.
B. ___ Sound
C. ___ A pendulum
D. ___ The pulse on the slinky shown below.

3. The pulse wave shown at the right is sent down a slinky from the left side.
   A. If the other end is fixed, what happens?
   B. If the other end is not fixed (free), what happens?

4. Words that we use for greater loudness include: more d_________; more a____________; greater i____________.

5. An orchestra is playing over a radio. Let's consider just two of the instruments: the flute and the tuba.
   - A. Which instrument probably has a higher pitch?
   - B. Which has a longer wavelength?
   - C. Which plays higher frequency notes?
   - D. If they play together, which notes gets to your ear first?
   - E. Which instrument's notes has a faster speed?
   - F. So, how does frequency affect the speed of sound?
   - G. If the tuba plays a very high note and the flute plays a very low note, they could play the same pitch (same f______________ f__________, but would sound different because they have different: t __________. (The two notes have different amounts [intensities] of the harmonics above the pitch.)

   And, by the way: frequency is something we can measure with scientific instruments; pitch is how humans perceive frequency. Just saying….

6. While two notes play at the same time, 3 beats per second are heard. One note is 345Hz
   A. Give the two possible frequencies of the other note.
   B. The second note can be adjusted. To make the notes more in-tune, the number of beats per second should increase or decrease?

7. A speaker pushes air pulses into the room.
   A. What is it producing?
   B. When is it audible (two ways)?
   C. What is the same between the speaker and the air?
   D. Which is compression when it pushes or pulls?
   E. What is the opposite of compression (see your "Harmonic Motion Table")?

Intensity (W/m^2)	dB
1.0×10^{-12}	0
1.0×10^{-11}	10
1.0×10^{-10}	20
1.0×10^{-9}	30
1.0×10^{-8}	40
1.0×10^{-7}	50
1.0×10^{-6}	60
1.0×10^{-5}	70
1.0×10^{-4}	80
1.0×10^{-3}	90
1.0×10^{-2}	100
1.0×10^{-1}	110
1.0×10^{0}	120

8. A sound increases from by 1.0×10^{-4} W/m^2 to 1.0×10^{-3} W/m^2.
   A. What fundamental part of the sound changed?
   B. By how many decibels did the sound change?
   C. Divide the large intensity by the smaller intensity and you get:
   D. So, 10 more dB = how much more intensity?
   E. Divide the intensity of 90 dB by the intensity of 60 dB and you get:

   F. So, + 30 dB = how much more intensity?

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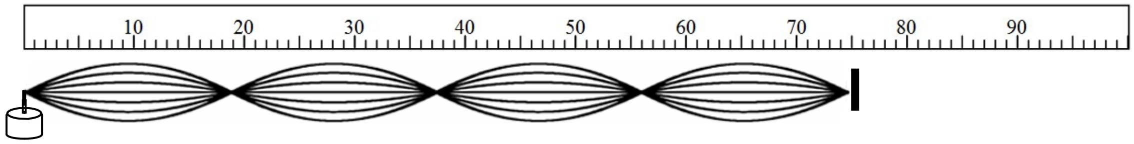
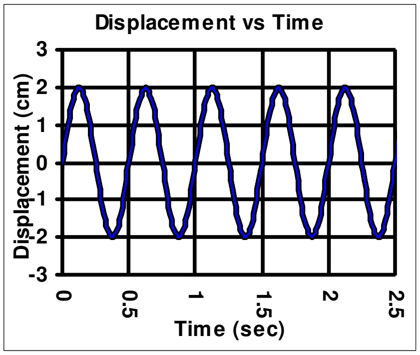
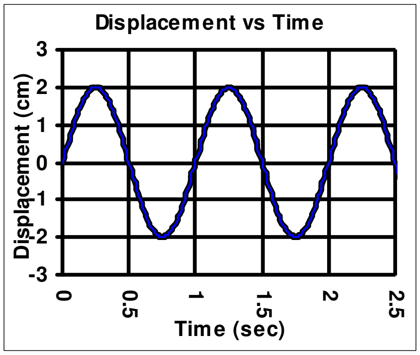


9. A string is vibrated on the left side by an adjustable mechanical vibrator. The right side is fixed.
   A. The above shape is known as a:
   B. Will this type of shape (and the others) happen at every frequency of vibration?
   C. These shapes occur only when the driving frequency matches the r__________ frequency (or frequencies) of the string.
   D. As the number of antinodes increases, the amplitude of each antinode:
   E. So (for sound) the LOUDEST possible harmonic is always the:
   F. Give the three longest possible wavelengths for this length string.

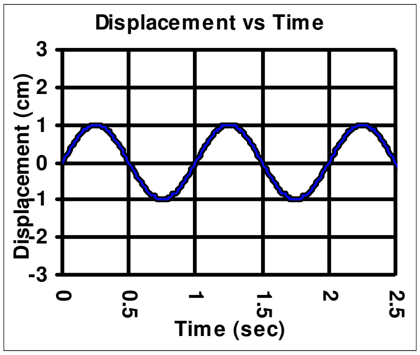
10. Match the pendulums, springs, and graphs below.



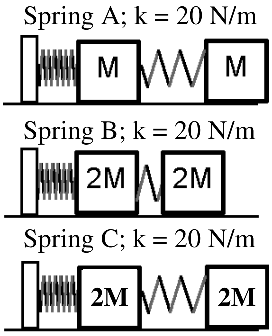
Spring ____ Pendulum ____

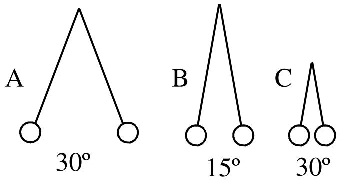


Spring ____ Pendulum ____



Spring ____ Pendulum ____





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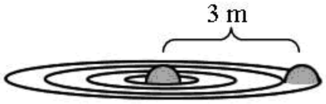


1. Two beach balls are floating in water with a separation distance of 3 m. When the first ball is pushed down 5 cm into the water it vibrates up and down 6 times per second. The second ball starts to bounce 0.2 seconds later.

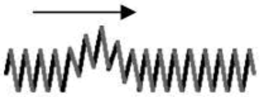
   A. What is the amplitude of the first ball? 5cm (will bob 10cm from top to bottom)

   B. Calculate the speed of the wave. $S = \frac{D}{T} = \frac{3m}{.2sec} = 15 m/sec$

   C. Calculate the wavelength of the wave. $V = F\lambda$

2. Longitudinal or Transverse wave?

   A. T A standing wave on a string. (you pull it sideways)
   B. L Sound (a speaker pushes)
   C. n/a A pendulum neither ("Hap Hap", Nelson)
   D. T The pulse on the slinky shown below.



3. The pulse wave shown at the right is sent down a slinky from the left side.
   A. If the other end is fixed, what happens? inverts (returns opp. side)
   B. If the other end is not fixed (free), what happens? comes back same side

4. Words that we use for greater loudness include: more decibels; more amplitude; greater intensity.

5. An orchestra is playing over a radio. Let's consider just two of the instruments: the flute and the tuba.

   A. Which instrument probably has a higher pitch? Flute

   B. Which has a longer wavelength? tuba (longer and lower note)

   C. Which plays higher frequency notes? Flute (shorter λ)

   D. If they play together, which notes gets to your ear first? same time.

   E. Which instrument's notes has a faster speed? same medium (air), same velocity

   F. So, how does frequency affect the speed of sound? doesn't

   G. If the tuba plays a very high note and the flute plays a very low note, they could play the same pitch (same fundamental frequency, but would sound different because they have different: timbres. (The two notes have different amounts [intensities] of the harmonics above the pitch.)F

   And, by the way: frequency is something we can measure with scientific instruments; pitch is how humans perceive frequency. Just saying….

6. While two notes play at the same time 3 beats per second are heard. One note is 345Hz
   A. Give the two possible frequencies of the other note. +3 = 348 Hz / −3 = 342Hz
   B. The second note can be adjusted. To make the notes more in-tune, the number of beats per second should increase or [✓ decrease]? no beats = in tune

7. A speaker pushes air pulses into the room.
   A. What is it producing? longitudinal (compression) waves
   B. When is it audible (two ways)? btwn 20 – 20,000 Hz or loud enough (enough dB)
   C. What is the same between the speaker and the air? Freq.
   D. Which is compression when it [✓ pushes] or pulls?
   E. What is the opposite of compression (see your "Harmonic Motion Table")? rarefaction

Intensity (W/m²)	dB
1.0×10^{-12}	0
1.0×10^{-11}	10
1.0×10^{-10}	20
1.0×10^{-9}	30
1.0×10^{-8}	40
1.0×10^{-7}	50
1.0×10^{-6}	60
1.0×10^{-5}	70
1.0×10^{-4} *	80
1.0×10^{-3} *	90
1.0×10^{-2}	100
1.0×10^{-1}	110
1.0×10^{0}	120

8. A sound increases from by 1.0×10^{-4} W/m² to 1.0×10^{-3} W/m².
   A. What fundamental part of the sound changed? amplitude
   B. By how many decibels did the sound change? 10dB
   C. Divide the large intensity by the smaller intensity and you get: 10
   D. So, 10 more dB = how much more intensity? 10 times as intense
   E. Divide the intensity of 90 dB by the intensity of 60 dB and you get:

   $$\frac{1\times10^{-3}}{1\times10^{-6}} = 1000$$

   F. So, + 30 dB = how much more intensity? 1000 times

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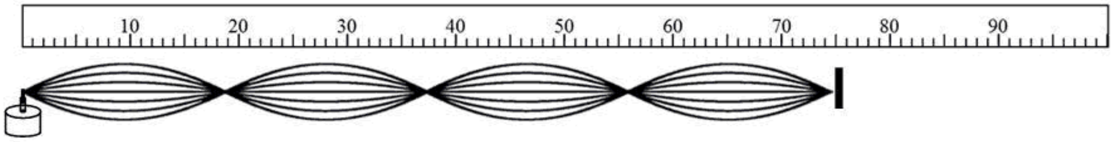
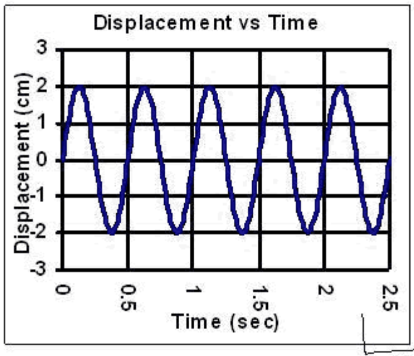
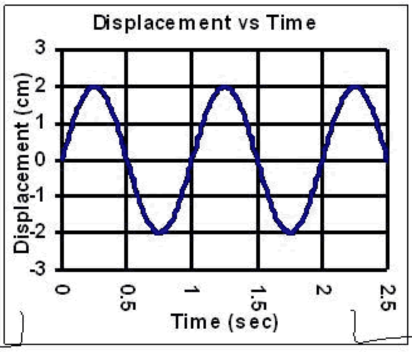


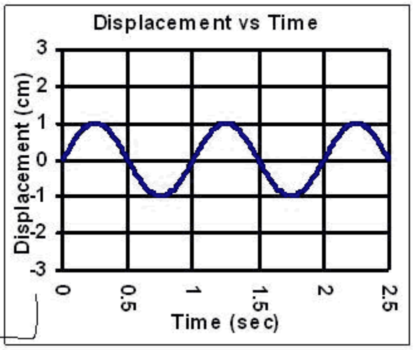
9. A string is vibrated on the left side by an adjustable mechanical vibrator. The right side is fixed.
   - A. The above shape is known as a: harmonic
   - B. Will this type of shape (and the others) happen at every frequency of vibration? No
   - C. These shapes occur only when the driving frequency matches the r<u>esonant</u> frequency (or frequencies) of the string.
   - D. As the number of antinodes increases, the amplitude of each antinode: decreases
   - E. So (for sound) the LOUDEST possible harmonic is always the: natural or fundamental
   - F. Give the three longest possible wavelengths for this length string.

$\underset{L}{(.75)}2 = \boxed{1.5\text{ m}}$, $\boxed{.75\text{ m}}$, $\frac{1.5}{3} = \boxed{.5\text{ m}}$

10. Match the pendulums, springs, and graphs below.



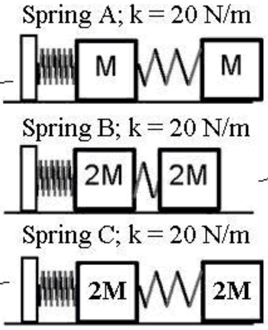




same A

same T

Spring <u>A</u> Pendulum <u>C</u> Spring <u>C</u> Pendulum <u>A</u> Spring <u>B</u> Pendulum <u>B</u>

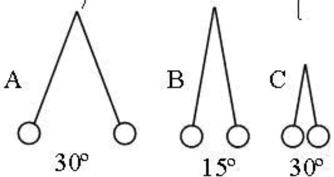


faster (less m)

same A

same T

same A



faster: shorter

same T

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