A-Day: Due Thurs., Mar 31
B-Day: Due Fri., Apr 1 (no, really!)

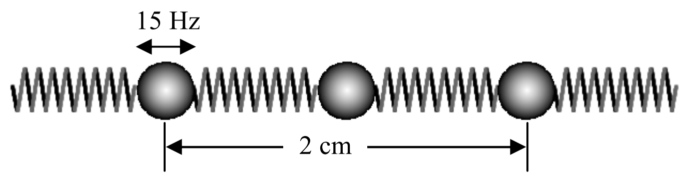
2011 PreAP Harmonic Motion 3

At this point I have to assume that you can find the period of a pendulum and a spring AND that you know what affects their periods. If you need to redo the lab, come in and take care of it.

From the "Waves" notes:

1. What is the medium for water waves? For sound in a room?
2. What moves in wave motion: the actual particles in the medium or the energy?
3. A wave has a wavelength of 45 m and a frequency of 13 Hz, what is its speed?
4. What kind of wave: longitudinal or transverse?
   A. When the slinky is moved side to side. B. When the slinky is pushed.
   C. If the slinky vibrates perpendicular to the direction it travels.

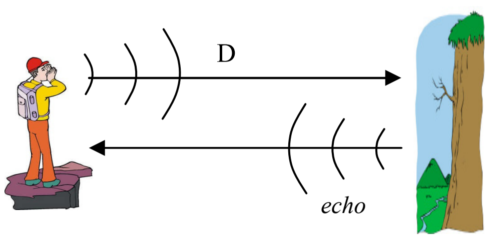
5. Which has a faster wave: a loose slinky or a tight slinky?
6. Will a wave move faster if the molecules are close together or far apart?



7. Three ping pong balls are attached by springs. The first of the balls has a frequency of 15 Hz.
   A. What is the frequency of the third ball?
   B. What kind of wave is it?
   C. If it takes 0.6 seconds for the wave to move from ball 1 to ball 3, calculate the speed of the wave.
   (*Notice distance is in cm [hint, hint]*).

   D. Now that you have the speed, calculate its wavelength.

8. A wave has a frequency of 120Hz and a wavelength of 9 m.
   A. What is it speed?
   B. Using the units for speed, how far does the wave move in 40 seconds?



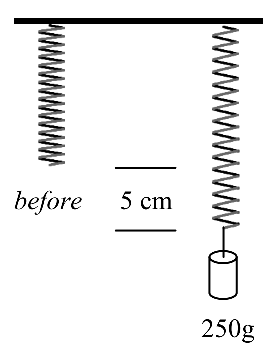
9. Imagine a boy standing in a canyon. He yells at the opposite wall of the canyon. The speed of sound is approximately 340 m/s.
   A. If the distance to the other side of the canyon is D, how far does the sound actually travel from the boy and back?

   B. If it takes 1.6 seconds from the moment the boy yells for the echo to get back to the boy, how far wide is the canyon?

10. A person hits a metal rail with a hammer. The sound travels down the 650 m rail and reflects off of a post at the end. A sensor detects the reflected sound 0.25 seconds after it is struck. What is the speed of sound in the rail?

When using T = #sec/#cycles (or f = #cycles/#sec), these words can be substituted for cycles: periods, vibrations, waves, wavelengths, crests (top of waves), back-and-forths.

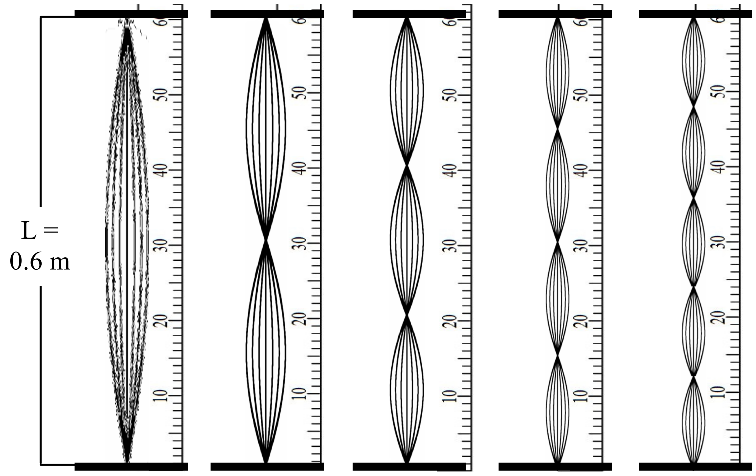
11. A spring bounces up and down 82 times in one minute. Calculate its period.



12. 15 wavelengths pass a point in 22 seconds. If the wave is moving 105m/s, calculate its frequency and wavelength.

13. A 250 g mass is hung on a spring. The spring stretches 5 cm.
    A. Calculate the spring constant of the spring.

    B. Calculate the period of the spring.



Harm	1	2	3	4	5
Freq	15 Hz	30 Hz	45 Hz	60 Hz	75 Hz
# of λ	½λ	1λ	1.5λ	2λ	2.5λ
λ	1.2 m	0.6 m	0.4 m	0.3 m	0.24 m
λ =	2L or 2L/1	L or 2L/2	(2/3)L or 2L/3	L/2 or 2L/4	(2/5)L or 2L/5

A string is vibrated at different frequencies. At certain frequencies it shows the shapes at the left. These are known as harmonics. (See your "Standing Waves" notes.) H_1 means harmonic 1. f_1 means the frequency of harmonic 1. λ_1 means the wavelength of harmonic 1. Other names for harmonic 1: natural frequency; fundamental. ***<u>Study</u>*** *the table and then answer the following:*

14. * To get from H_1 to H_4 you:

15. To get from H_5 to H_1 you:

16. To get from λ_1 to λ_3 you:

17. * To get from λ_4 to λ_1 you:

18. * To get from H_3 to H_2 you (two steps):

19. To get from λ_5 to λ_4 you:

20. * The wavelength of the fundamental is how many L?

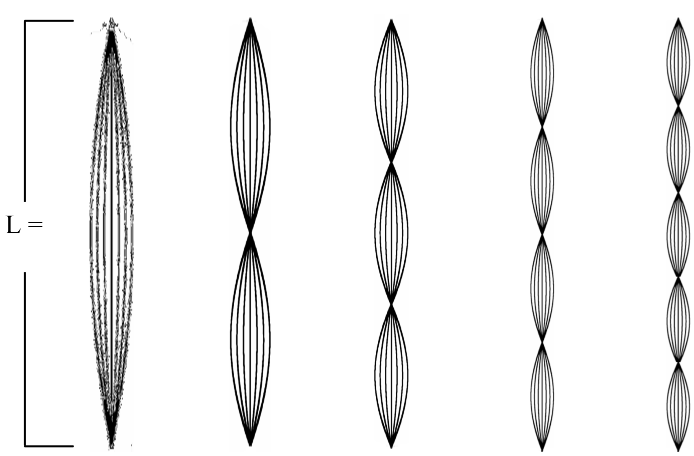
21. * If the third harmonic has a frequency of f, what is the frequency of harmonic 6?

22. If H_2 has a wavelength of L, what is the wavelength of harmonic 3?

23. If the fifth harmonic has a frequency of f, what is the frequency of the second harmonic?

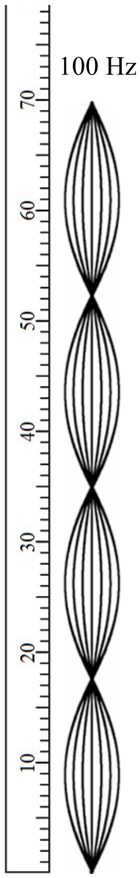
24. A string has a length of 40 cm. What is the wavelength of the fundamental (H_1)?

25. * A 30 cm long string has a third harmonic of 120 Hz.
    A. What is the wavelength of the fundamental?
    B. What is the fundamental's frequency (this string's natural frequency)?
    C. Calculate the wave speed.



Harm					
Freq			36 Hz		
# of λ					
λ					

26. A 0.75m string is vibrated at different frequencies.
    A. These shapes are known as what?
    B. Give the three names for shape 1.
    C. Fill in the chart.
    D. Calculate the period of harmonic 3.
    E. What is the velocity of harmonic 2's wave?
    F. What is the velocity of harmonic 5's wave?
    G. What changes if the string is tightened?



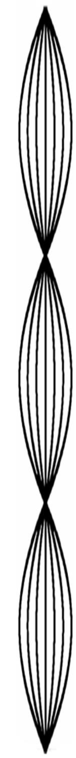
27. A string is vibrated at 100 Hz, as shown at the left.
    A. What harmonic is shown at the left?
    B. How many antinodes does it have?
    C. How many nodes does it have?
    D. What is the wavelength of the harmonic (in m)?
    E. If its frequency is 100 Hz, what is its velocity?
    F. What would be the frequency of the 1st harmonic?

28. The frequency of vibration of the same string is changed until the shape shown at the right is seen.
    A. What harmonic is shown at the right?
    B. Mark the nodes and antinodes.
    C. What do you notice about the number of nodes vs. antinodes?

    D. What must be the frequency of the right harmonic?
    E. What would be the velocity of this harmonic's wave?

    F. During the lab, when the frequency went up (bigger #), the wavelength went ____________ and the velocity:

    G. Since the length of the string has not changed, what is the wavelength for this new harmonic?
    H. When you tightened the string, what two things changed?



From the "Slinky" Demo:

29. What kind of wave cannot exist in a liquid or gas?

30. Sound is what kind of wave?

31. If the other end of the slinky is fixed (can't move), how is the pulse wave reflected: inverted or on the same side as the incoming wave?

32. If the other end of the slinky is unfixed, how is the pulse wave reflected?

Q14) multiply by 4 Q17) mult by 4 Q18) Divide by 3 then mult by 2

Q20) 2L Q21) div by 3 to get to H1, then mult by 6, so 6f/3 or 2f

Q25) A. 2(.30) = 0.6 m B. 120/3 = 40 Hz C. $v = f\lambda = 40(0.6) = 24$ m/s