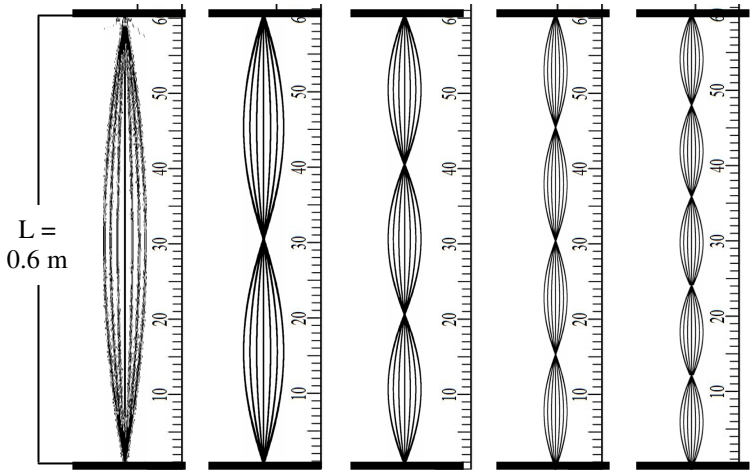
2011-12 PreAP Harmonic Motion 7



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

1. String is vibrated at different frequencies. At certain frequencies it shows the shapes at the left, called standing waves. If they are all from the same string they are called harmonics. 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. **Study** the table and then answer the following:

   A. * To get from f_1 (15Hz) to f_4 you:

   B. To get from f_5 to f_1 you:

   C. To get from λ_1 to λ_3 you:

   D. * To get from λ_4 to λ_1 you:

   E. * To get from f_3 to f_2 you (two steps):

   F. To get from λ_5 to λ_4 you:

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

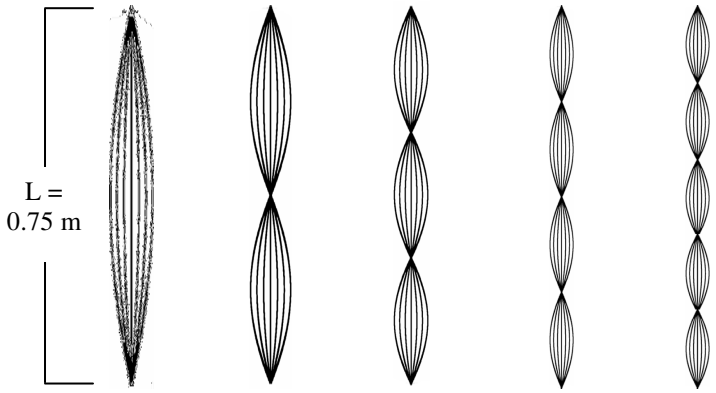
2. * A different string has a third harmonic with a frequency of "f", what is the frequency of harmonic 6?

3. * Yet a different string has $\lambda_2 = L$, what is the wavelength of its third harmonic?

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

5. A string has a length of 40 cm. What is the wavelength of the fundamental (λ_1)?

6. * 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.



Freq	*		36 Hz		
# of λ					
λ	*				
v					

7. A 0.75m string is vibrated at different frequencies.
   A. These shapes are known as what?

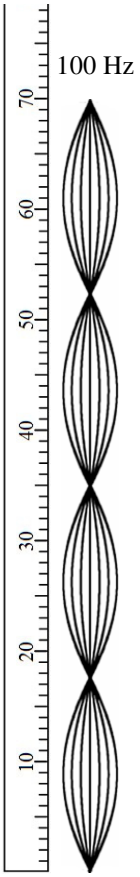
   B. Give the three names for shape 1.

   C. Fill in the chart. (*Notice the asterisks*)
   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?



8. 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?

9. The frequency of vibration of <u>the same string</u> is changed until the shape shown at the right is seen.

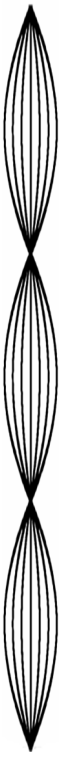
   A. What harmonic is shown at the right?
   B. Mark the nodes and antinodes.
   C. What do you notice about the number of nodes vs. antinodes?

   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 (same string), what is the wavelength for this new harmonic?

   H. If you tightened the string, what two things will change?



Q1A) multiply by 4 Q1D) mult by 4 Q1AE) Divide by 3 then mult by 2

Q1G) 2L 3) Well $\lambda_1 = 2L$, so $\lambda_3 = 2L/3$

Q8) div by 3 to get to H_1, then mult by 6, so 6f/3 or 2f

Q6) A. 2(.30) = 0.6 m B. 120/3 = 40 Hz C. $v = f\lambda = 40(0.6) = 24$ m/s

Q7C) $\lambda_1 = 2L$ $f_1 = f_3/3$

Q8C) 5 nodes