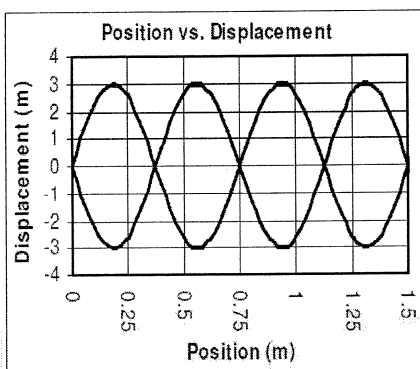


- Standing wave D A. Where wave's amplitude is greatest.
- Harmonic C B. Where the wave has no motion.
- Fundamental E C. A wave that is a multiple of another wave.
- Natural Frequency F D. A wave that is trapped within boundaries.
- Node B E. The first harmonic of a standing wave, equal to 1/2 its wavelength.
- Anti-node A F. The frequency at which any space will vibrate when disturbed.



of cycles: 2
 Wavelength: 0.75
 Amplitude: 3
 # of Anti-nodes: 4
 Harmonic #: 4th

Why does a violin have a wood body instead of just strings?
The wood gives resonance to amplify the strings
 Sometimes when talking or singing in a room, certain notes get very loud. Why? If note matches size of room, then resonance occurs

A string has a fundamental (first harmonic) of 15 Hz, find the frequency of harmonic 3 (H_3).

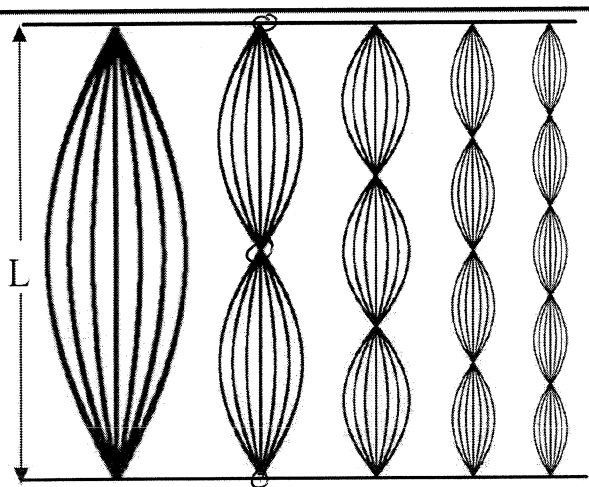
$$fH_n = n(H) = 15\text{Hz} \cdot H_3 = 45\text{Hz}$$

If 20 Hz is the fundamental, find H_6 .

$$120\text{Hz}$$

If 35 Hz is H_7 , what is the fundamental frequency?

$$H = \frac{fH_n}{n} = \frac{35\text{Hz}}{7} = 5\text{Hz}$$



- B Is the second harmonic. B Has a wavelength of L.
D Has 4 anti-nodes. E Is the highest frequency.
B Has 3 nodes. A Longest wavelength.
C Has a length of 1.5λ . all same Fastest wave speed.
A Is the fundamental. A Is the natural frequency.

String A has a fundamental with a period of 0.25 seconds.
 A) What is the fundamental's frequency?

$$f = \frac{1}{T} = \frac{1}{0.25} = 4\text{Hz}$$

B) How many antinodes does it have? 2

C) If the fundamental is on a 6 m long string, what is its wavelength?
 $\lambda_{fund} = 2(\text{length}) = 6\text{m} \cdot 2 = 12\text{m}$

D) Find the speed of the wave on that string.

$$V = f\lambda = 4\text{Hz} \cdot 12\text{m} = 48\text{m/s}$$

E) What would be the frequency of the third harmonic?

$$4\text{Hz} \cdot 3 = 12\text{Hz}$$

F) What is the wave speed of the fourth harmonic? 48m/s

The following table shows the frequencies of the first 5 harmonics of different strings. Fill in the blank spaces.

1	2	3	4	5
4 Hz	8 Hz	12 Hz	16 Hz	20 Hz
6 Hz	12	18	24	30
<u>2</u>	4 Hz	<u>6</u>	<u>8</u>	<u>10</u>
<u>12</u>	<u>24</u>	36 Hz	<u>48</u>	<u>60</u>
<u>11</u>	<u>22</u>	<u>33</u>	44 Hz	<u>55</u>

A fellow student shows you the frequencies of four harmonics of a string. Which one would you question and why?
 Frequencies: 12 Hz; 24 Hz; 29 Hz; 48 Hz

Not multiple of 12

Find its period: $T = 1/f = \frac{1}{40\text{Hz}} = 0.025\text{s}$

Mark the nodes and anti-nodes.

What harmonic is this? 2

Fundamental frequency = 20 Hz

3rd harmonic frequency = 60 Hz

Wavelength = 3m

Speed of the wave = $V = f\lambda = 40\text{Hz} \cdot 3\text{m} = 120\text{m/s}$

Speed of 5th harmonic = 120m/s doesn't change

