



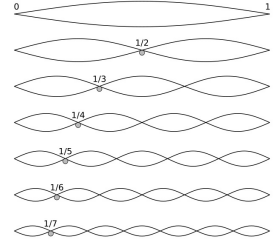
## CH4-5: Standing Longitudinal Waves

Note: this topic is not covered in CH04 of the textbook. These notes and other books and web sites are your best resources for this material.



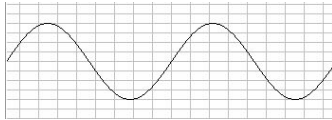
## Standing Waves on a String

A standing wave only occurs when the wavelength corresponds to the length of the string in just the right way. In these examples, **the string is fixed at both ends**.



### Poll

What harmonic (n) is a standing wave with this shape?

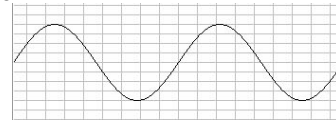


1. 2
2. 3
3. 4
4. 5
5. 6



### Poll

How many nodes and antinodes does this standing wave have?

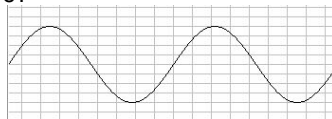


1. 5 nodes, 4 antinodes
2. 4 nodes, 4 antinodes
3. 5 nodes, 5 antinodes
4. 3 nodes, 2 antinodes
5. 6 nodes, 5 antinodes



### Poll

If the length of the string is 2 m, what is the wavelength of the wave?



1. 0.5 m
2. 1.0 m
3. 1.5 m
4. 2.0 m
5. 4.0 m



## Wave speed depends on the medium

Newton's second law can be used to derive the speed of a wave on a string. It depends on the tension in the string and the linear density of the string.



# Longitudinal Standing Wave



# Displacement node is a pressure antinode



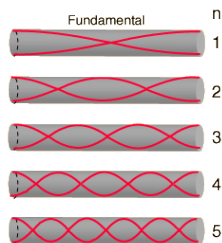
# Boundary conditions: closed pipe



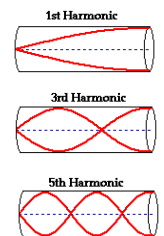
# Boundary conditions: open pipe



# Pipe open at both ends



# Pipe closed at one end and open at the other end





### Poll

At the open end of a pipe, the \_\_\_\_ is a node and the \_\_\_\_ is an antinode.

1. pressure, displacement
2. displacement, pressure
3. None of the above; both displacement and pressure are nodes
4. None of the above; both displacement and pressure are antinodes.



### Poll

At the closed end of a pipe, the \_\_\_\_ is a node and the \_\_\_\_ is an antinode.

1. pressure, displacement
2. displacement, pressure
3. None of the above; both displacement and pressure are nodes
4. None of the above; both displacement and pressure are antinodes.



### Poll

What harmonic is shown below?



1. 3
2. 4
3. 5
4. 6
5. 7



### Poll

What is harmonic is shown below?



1. 1
2. 3
3. 5
4. 7
5. 9