Key

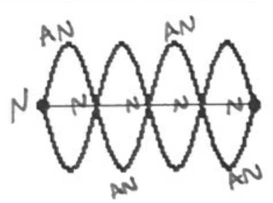
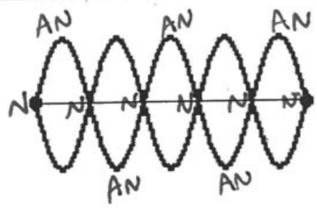
Standing Waves Worksheet

A standing wave pattern results in a string, rope or slinky as a result of the interaction between the waves introduced on one end with the reflection of the waves returning from the opposite end. At certain frequencies, a pattern will be established within the medium in which there are positions that always appear to be stationary. Midway between each of these stationary positions are positions which are undergoing rapid motion between a maximum positive and maximum negative displacement from their resting position.

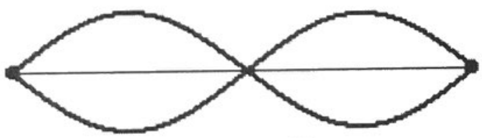
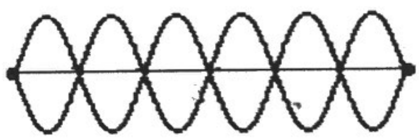
1. The positions along the medium that appear to be stationary are known as nodes. They are points of no displacement.

2. The positions along the medium that are undergoing rapid motion between a maximum positive and maximum negative displacement are known as Antinodes. They are the opposite of the points of no displacement.

3. Label the nodes (N) and antinodes (AN) in the following standing wave patterns.

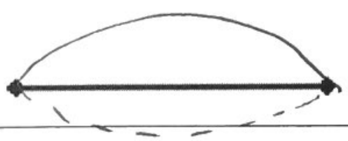
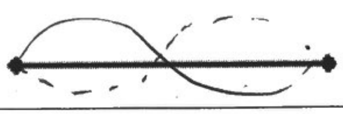
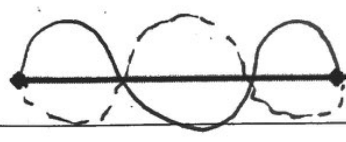
	

4. In each of the two diagrams of standing wave patterns, count the number of nodes and antinodes.

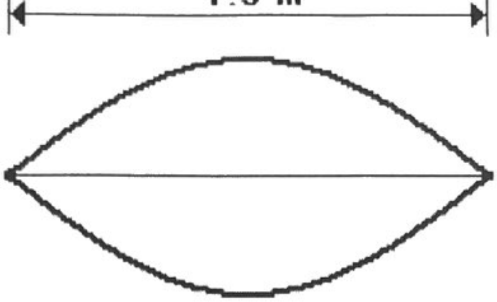
 3 nodes 2 AN	 7 Nodes 6 AN

5. Each node is separated by the adjacent node by a distance that is equal to 1/2 wavelength.

6. Draw the standing wave pattern that would result on the string below if the string vibrated with the first, second, and third harmonic wave patterns. State the relationship between length and wavelength for each of the three patterns.

1st Harmonic	2nd Harmonic	3rd Harmonic
		
L = 1/2 λ	L = 2/2 λ	L = 3/2 λ

7. The string at the right is 1.5 meters long and is vibrating as the first harmonic. The string vibrates up and down with 33 cycles in 10.0 seconds. Determine the frequency, period, wavelength and speed for this wave.



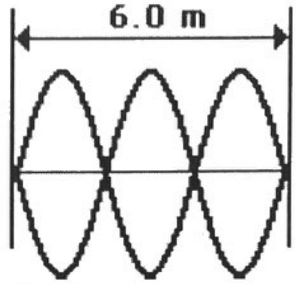
$f = \frac{cycles}{second}$ $\frac{33}{10} = $ **3.3 Hz**

$T = \frac{1}{f}$ $T = \frac{1}{3.3}$ **T = .3 s**

$L = \frac{n}{2}\lambda$ $1.5 = \frac{1}{2}\lambda$ **λ = 3 m**

$V = f\lambda$ $V = 3.3 Hz(3 m) = $ **9.9 m/s**

8. The string at the right is 6.0 meters long and is vibrating as the third harmonic. The string vibrates up and down with 45 cycles in 10.0 seconds. Determine the frequency, period, wavelength and speed for this wave.



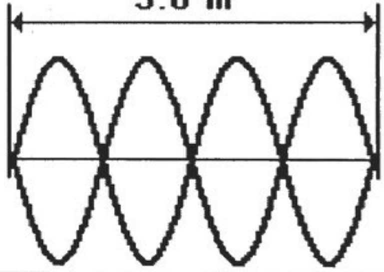
$f = \frac{cycles}{second}$ $\frac{45}{10} = $ **4.5 Hz**

$T = \frac{1}{f}$ $T = \frac{1}{4.5} = $ **0.22 s**

$L = \frac{n}{2}\lambda$ $6 = \frac{3}{2}\lambda$ **λ = 4 m**

$V = f\lambda$ $V = 4.5 Hz(4 m) = $ **18 m/s**

9. The string at the right is 5.0 meters long and is vibrating as the fourth harmonic. The string vibrates up and down with 48 cycles in 20.0 seconds. Determine the frequency, period, wavelength and speed for this wave.



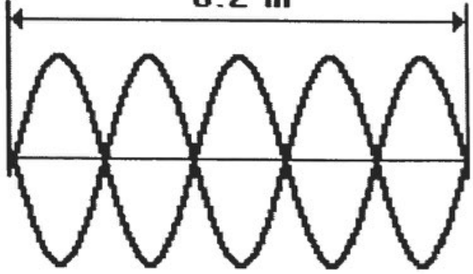
$f = \frac{cycles}{second}$ $\frac{48}{20} = $ **2.4 Hz**

$T = \frac{1}{f} = \frac{1}{2.4} = $ **.42 s**

$L = \frac{n}{2}\lambda$ $5 = \frac{4}{2}\lambda$ **λ = 2.5 m**

$V = f\lambda$ $V = (2.4 Hz)(2.5 m) = $ **6 m/s**

10. The string at the right is 8.2 meters long and is vibrating as the fifth harmonic. The string vibrates up and down with 21 cycles in 5.0 seconds. Determine the frequency, period, wavelength and speed for this wave.



$f = \frac{cycles}{second}$ $\frac{21}{5} = $ **4.2 Hz**

$T = \frac{1}{f}$ $T = \frac{1}{4.2}$ **T = .24 s**

$L = \frac{n}{2}\lambda$ $8.2 = \frac{5}{2}\lambda$ **λ = 3.28 m**

$V = f\lambda$ $V = (4.2 Hz)(3.28 m) = $ **13.8 m/s**