SPH3U0 **Standing Waves** Name: ANSWERS.

Instructions: Read pages 313-314 and complete the following questions.

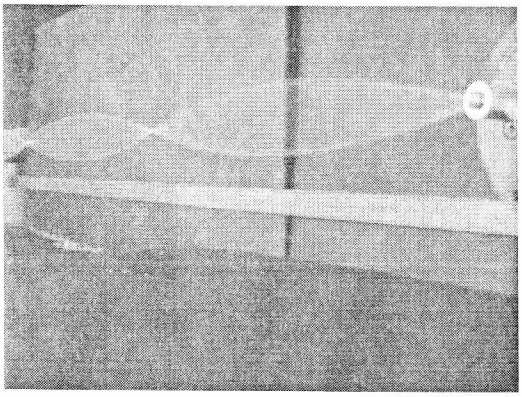
Standing waves are produced when two waves with IDENTICAL wavelengths and AMPLITUDES move through each other.

When crests from two waves or troughs from two waves occupy the same point in the medium, the waves are said to be IN PHASE. These waves produce CONSTRUCTIVE interference.

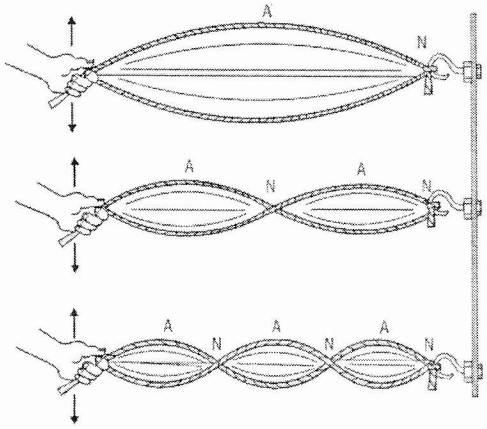
When a crest from one wave occupies the same point in the medium as a trough from a second wave, we say that the waves are OUT OF PHASE. These waves produce DESTRUCTIVE interference.

As the two waves pass through each other, they continually shift in and out of PHASE producing a wave that seems to OSCILLATE between fixed points.

An image of a standing wave produced in a vibrating string:



Picture of various standing wave patterns produced at different vibration frequencies:



Nodes and Anti-Nodes:

At certain points, destructive interference will always occur. (See point A in figure 9.38). What are these points called? NODES

What is the spacing of these points? $\frac{1}{2}\lambda$

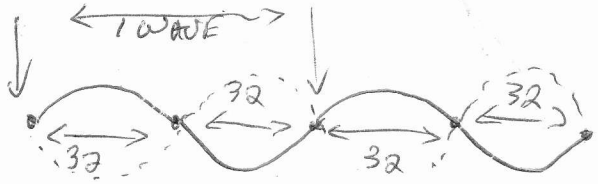
In between these points, the waves switch between constructive and destructive interference. The midpoints of these regions are called ANTI NODES.

Sketch a standing wave as shown in figure 9.40. Label the nodes, anti-nodes and the spacing between nodes

Analyzing Standing Waves

Sample Question: Two physics students playing with a long spring, produced a 4 loop standing wave by vibrating the ends at the same frequency and amplitude. They determined that the nodes in their wave were spaced 32.0 cm apart. If they were vibrating the spring at a frequency of 2.0 Hz, find:

a) the wavelength of the waves b) the speed of the waves.



4 LOOPS

2 WAVES

a) NODE SPACING $= \frac{1}{2}\lambda$

SO $\lambda = 2(32) = 64$ cm

b) $v = \lambda f$ $f = 2.0$ Hz

$v = (64.0)(2.0)$

$= 128.0$ cm/s $= 1.3$ m/s

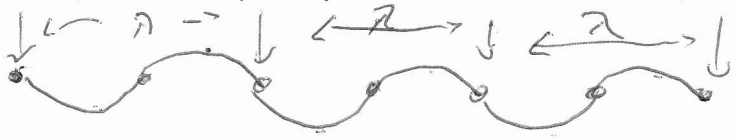
1) A 16.0 m long string vibrates in a standing wave pattern such that 6 loops are produced.

a) Sketch the standing wave.

b) What is the wavelength of the wave?

c) If the frequency of vibration is 2.50 Hz, calculate the wave speed.

a)



6 LOOPS = 3 WAVES.

b) 3 WAVES = 16.0 m

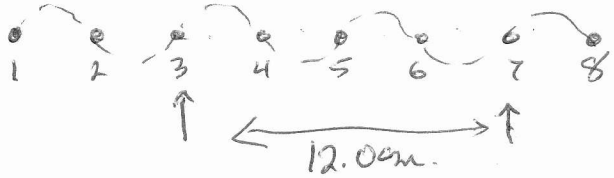
1 WAVE = $\frac{16.0}{3}$ m

$\lambda = 5.33$ m.

c) $v = \lambda f$

$= (5.33)(2.50) = 13.3$ m/s

2) A standing wave is produced in a string by two waves travelling in opposite directions at a speed of 5.40 m/s. The distance between the third and seventh node is 12.0 cm. Find the wavelength and frequency of the waves.



= 4 NODE SPACINGS

SO 1 NODE SPACING = 3.00 cm.

FIND λ:

1 NODE SPACE $= \frac{1}{2}\lambda$.

3.00 cm $= \frac{1}{2}\lambda$

$\lambda = 6.00$ cm.

$\lambda = 0.06$ m.

FIND f

$f = v/\lambda$

$f = \frac{5.40 \text{ m/s}}{0.06 \text{ m}} =$

Answers: 1) a) 5.33 m b) 13.3 m/s 2) $\lambda = 0.600$ m f = 9.00 Hz

Classwork/Homework: Questions: #3, 8, 9,12 pg. 317 (Section 9.3)