AP PHYSICS
Name: _____
Period: _____ Date: _____

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

GIANCOLI READING ACTIVITY

Section 11-11 to 11-12 (5 Points)

1. Big Idea(s): Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
2. Enduring Understanding(s):
   a. Only waves exhibit interference and diffraction.
   b. Interference and superposition lead to standing waves and beats.
3. Essential Knowledge(s):
   a. When two waves cross, they travel through each other; they do not bounce off each other. Where the waves overlap, the resulting displacement can be determined by adding the displacements of the two waves. This is called superposition.
   b. Two or more wave pulses can interact in such a way as to produce amplitude variations in the resultant wave. When two pulses cross, they travel through each other; they do not bounce off each other. Where the pulses overlap, the resulting displacement can be determined by adding the displacements of the two pulses. This is called superposition.
   c. Two or more traveling waves can interact in such a way as to produce amplitude variations in the resultant wave.
   d. Standing waves are the result of the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. Examples should include waves on a fixed length of string, and sound waves in both closed and open tubes.
   e. The possible wavelengths of a standing wave are determined by the size of the region to which it is confined.
      i. A standing wave with zero amplitude at both ends can only have certain wavelengths. Examples should include fundamental frequencies and harmonics.
      ii. Other boundary conditions or other region sizes will result in different sets of possible wavelengths.
   f. Essential Knowledge 6.D.5: Beats arise from the addition of waves of slightly different frequency.
      i. Because of the different frequencies, the two waves are sometimes in phase and sometimes out of phase. The resulting regularly spaced amplitude changes are called beats. Examples should include the tuning of an instrument.
      ii. The beat frequency is the difference in frequency between the two waves.
4. Learning Objective(s):
   a. The student is able to make claims and predictions about the net disturbance that occurs when two waves overlap. Examples should include standing waves.

b. The student is able to construct representations to graphically analyze situations in which two waves overlap over time using the principle of superposition.

c. The student is able to use representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses.

d. The student is able to design a suitable experiment and analyze data illustrating the superposition of mechanical waves (only for wave pulses or standing waves).

e. The student is able to design a plan for collecting data to quantify the amplitude variations when two or more traveling waves or wave pulses interact in a given medium.

f. The student is able to analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes.

g. The student is able to refine a scientific question related to standing waves and design a detailed plan for the experiment that can be conducted to examine the phenomenon qualitatively or quantitatively.

h. The student is able to predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes.

i. The student is able to plan data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air.

j. The student is able to describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region.

k. The student is able to challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region.

l. The student is able to calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments.

m. The student is able to use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats.

5. Read sections 11-11 to 11-13 in your textbook.

6. Define the following terms:

a. reflection _____

_____

_____

b. wave fronts _____

_____

c. ray _____

_____

d. plane waves _____

_____

e. law of reflection _____

f. angle of incidence _____

g. angle of reflection _____

h. interference _____

i. principle of superposition _____

j. destructive interference _____

k. constructive interference _____

l. phase _____

m. in phase _____

n. out of phase _____

o. standing wave _____

p. nodes _____

q. anti-nodes _____

r. natural or resonant frequency _____

s. fundamental frequency _____

t. overtones or harmonics _____

u. first harmonic _____

v. second harmonic _____

7. Answer the following questions:

a. How is a rope pulse reflected,

i. if both ends are fixed? _____

ii. if one end is free? _____

b. Explain why a pulse on a rope with fixed ends reflects an inverted pulse. _____

c. Why, in real life, does a reflected pulse have less energy/lower amplitude? _____

d. In the law of reflection, how are the incident and reflected angles measured? _____

e. Two pulses approach each other ~~in a bar~~ in space. One is a crest with an amplitude of 8 and the other is a trough with an amplitude of 3. What will be the amplitude when they meet? _____

f. In terms of interference, what will happen if two waves meet at a certain point and one has a different frequency than the other? _____

g. "Resonant modes of vibration" occur at the different resonant frequencies which are _____

h. What is the relationship between length of a string and wavelength at the fundamental frequency?

i. Write two equations for the relationship between string length and wavelength for multiple harmonics

j. What's the deal with energy in a standing wave on a string? _____

_____

k. When driving a nail into a piece of wood, why does the 'pitch' increase with each strike of the hammer? (if you don't believe me, come try it out on my fence) _____

_____

_____

8. This assignment may be typed or neatly printed. Drawings may be freehand, but try to make use of the 'Shapes' or 'Insert Clipart" functions of MS Word. Try to use the Microsoft Equation function as much as possible. If you submit this assignment electronically, the filename must be in the following format, "LastnameFirstinitialPerXReadActX-X".