STUDY GUIDE

Simple Harmonic Oscillators:
Restoring Force proportional to distance
Energy, velocity and displacement all make a wave pattern.
Back & forth, up & down, revolution, cycle, wave, swing, all the same
Period: time per cycle
Frequency: 1/Period= cycle per sec = Hertz
In a pendulum: T = 2 pi * sqrt (length/ g)
In a spring T = 2 pi * sqrt (m/ k) k is spring constant

MOVING WAVES: (Chap 12)

I. Waves in general:
  A. Definition of wave: disturbance through a medium
  B. Parts of a wave/ measurements of a wave
    a. crest (high point), trough(low point)
    b. wavelength(crest to crest), amplitude(1/2 total height),
    c.frequency(# waves per second), speed (distance per time)
    d.SPEED: CHANGES WITH TEMPERATURE
  C. Transverse Waves
    a. Points move perpendicular to wave motion, b. crest, trough
  D. Longitudinal Waves

a. Points move with wave motion, b. compression, rarefaction

How does changing these properties affect slinky/rope or water waves?

Remember that Speed = Frequency times Wavelength
Tightness in a rope/Depth of Water >>>>> changes speed

Type of Material >>>>>> changes speed

Changing Frequency>>>>> changes wavelength NOT speed

Changing Amplitude (Strength/Height)>>> does NOT change frequency, wavelength or speed.

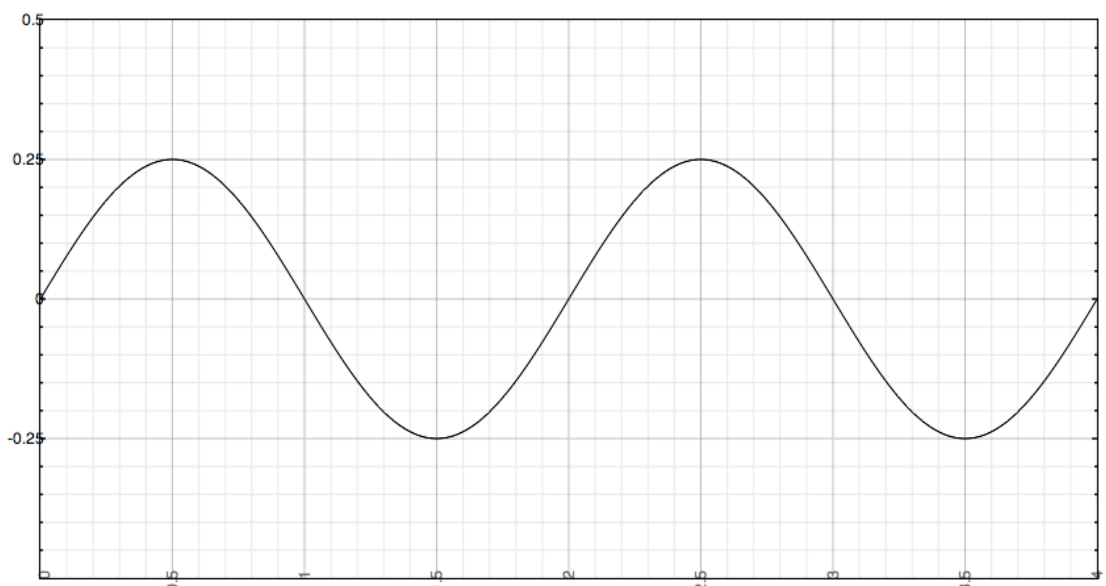
REFLECTION:
Waves bounce off a barrier in the opposite direction
REFRACTION:
Waves change direction when they go from one material to another (because of change in speed), like in a wave between two slinkys or from one depth of water to another.

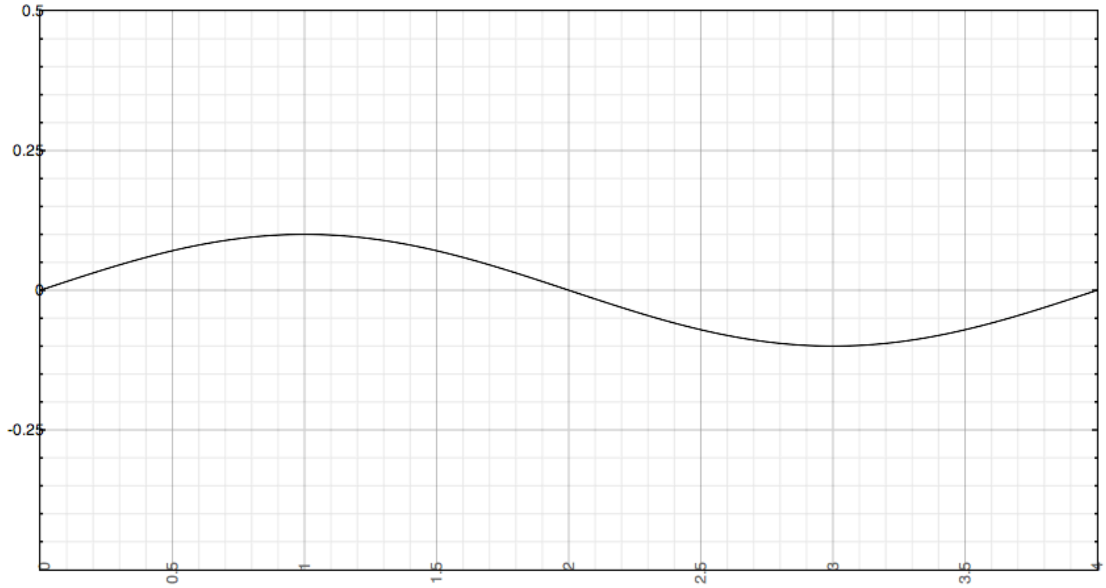
INTERFERENCE: When two waves meet they will either cancel or add up to a stronger one.

STANDING WAVES: when the intereference and the frequency are adjusted so that points or nodes appear not to move.
Wave interactions…. Follow principle of superposition (waves add up)

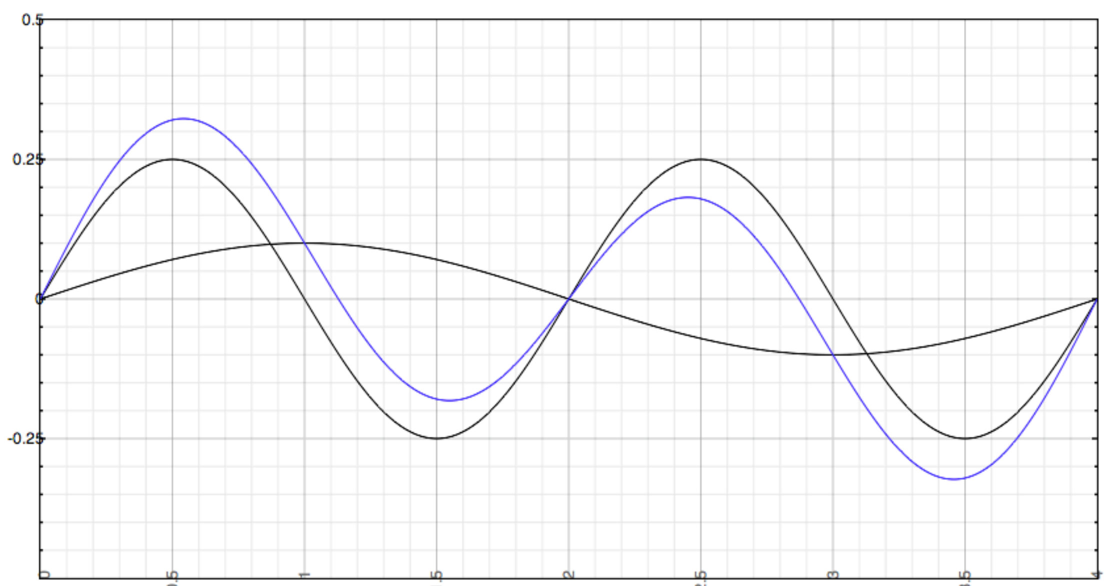
A wave of .25 cm amplitude with a wavelength of 2 m traveling on a string interferes with a wave of .10 cm amplitude with a wavelength of 4 m traveling the other way on the 4 m long string. (they both were started at the same time). The waves travel 20 m/s.

Sketch a graph of each individual wave for one period.





Sketch a graph of the wave resulting from interference.



Give examples of simple harmonic motion

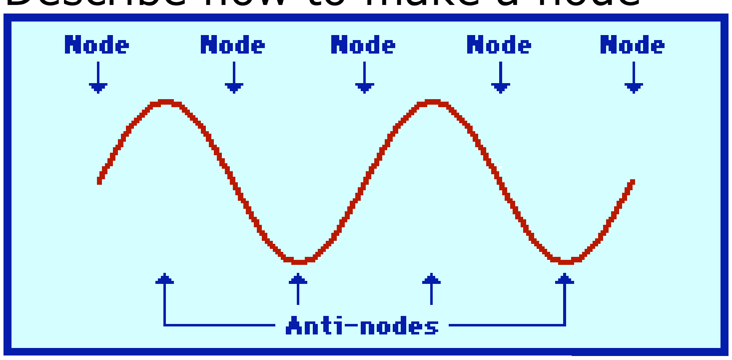
Describe exactly how to change the period of a pendulum

Describe the factors that affect the speed of a wave spring

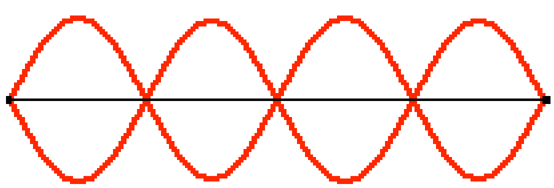
Describe how water, pendulum, slinky waves are alike and different.

Graph the acceleration and energy of a spring wave.

Describe how to make a node



Typical Diagram of a Standing Wave



Describe the difference between free and closed reflection

Explain the parts of a transverse and longitudinal wave, giving examples.

What is the principle of superposition?

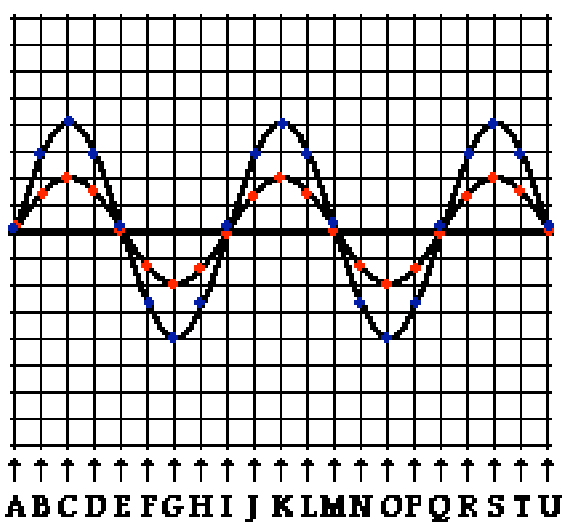
The task of determining the shape of the resultant demands that the principle of superposition is applied. The **principle of superposition** is sometimes stated as follows:

> When two waves interfere, the resulting displacement of the medium at any locatio
> of the individual waves at that same location.

In the cases above, the summing the individual displacements for locations of complete overlap was mad out to be an easy task - as easy as simple arithmetic:

Displacement of Pulse 1	Displacement of Pulse 2
+1	+1
-1	-1
+1	-1
+1	-2

In actuality, the task of determining the complete shape of the entire medium during interference demands that the principle of superposition be applied for every point (or nearly every point) along the medium. As an example of the complexity of this task, consider the two interfering waves at the right.



A snapshot of the shape each of the individual waves at a particular instant in time is shown. To determine the precise shape of the medium at this given instant in time, the principle of superposition must be applied to several locations along the medium. A short-cut involves measuring the displacement from equilibrium at a few strategic locations. Thus, approximately 20 locations have been picked and labeled as A, B, C, D, etc. The actual displacement of each individual wave can be counted by measuring from the equilibrium position up to the particular wave. At position A, there is no displacement for either individual wave; thus, the resulting displacement of the medium will be 0 units. At position B, the smaller wave has a displacement of approximately 1.4 units; the larger wave has a displacement of approximately 2 units; thus, the resulting displacement of the medium will be approximately 3.4 units. At position C, the smaller wave has a displacement of approximately 2 units; the larger wave has a displacement of approximately 4 units; thus, the resulting displacement of the medium will be approximately 6 units. At position D, the smaller wave has a displacement of approximately 1.4 units; the larger wave has a displacement of approximately 2 units; thus, the resulting displacement of the medium will be approximately 3.4 units. This process can be repeated for every position. When finished, a dot (done in green below) can be marked on the "graph" to note the displacement of the medium at each given location. The actual shape of the medium can then be sketched by estimating the position between the various marked points and sketching the wave. This is shown as the green line in the diagram below.