Physics 100 - Spring 2007 - Recitation 4

(1) Red light has a wavelength of 700 nm.
Light in a vacuum travels at 3×10^8 m/s
What is the frequency of red light?
What is the period of the electric and magnetic field oscillations in red light?

What is the frequency and period of radio waves with a wavelength of 100 km?

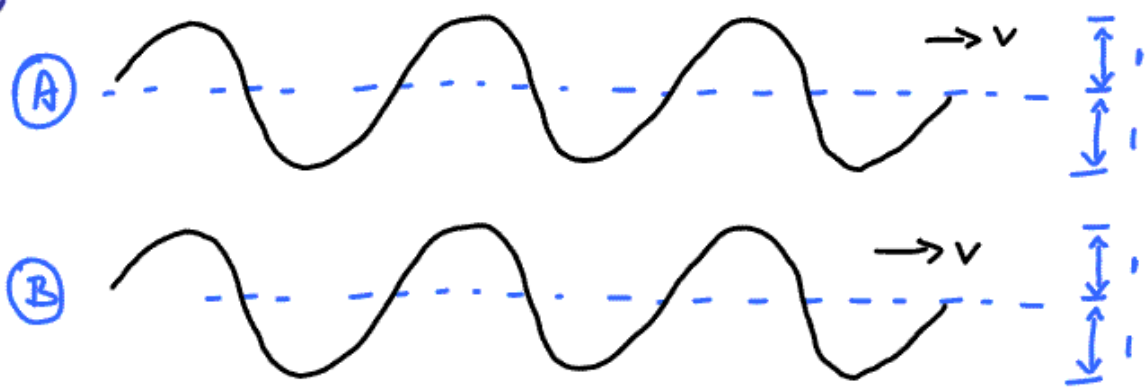
(2) which has the longer wavelength – blue light or red light?
which photons have more energy – photons of blue light or photons of red light?

(3) Every gradeschooler knows that if you mix yellow with blue you can get green ...

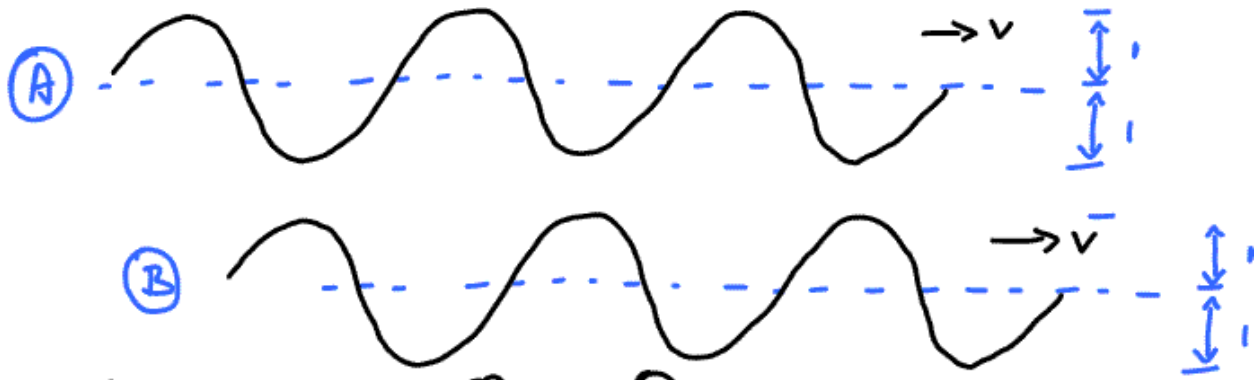
Does this mean if I shoot a beam of yellow light ($\lambda = 550$ nm) into a beam of blue light ($\lambda = 450$ nm) that I get a beam of green light ($\lambda = 500$ nm) ?

Why or why not ?

(4)



Suppose waves (A) and (B) travel in space together. How would the wave resulting from wave (A) and (B) interfering appear ?



Suppose waves (A) and (B) travel in space together. How would the wave resulting from wave (A) and (B) interfering appear?

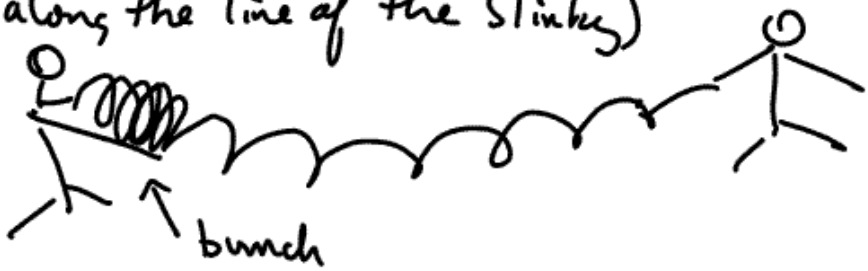
(5) Look around at the walls on the sides of Hoyt Auditorium. You will see many strangly shaped objects on the walls. Why are they there? Is it just for decoration ... or something more?

(6)

2 Members of your group should lightly stretch a slinky a distance of about 3 or 4 meters.

Caution: Do not stretch the slinky too much or it will not recoil properly ... ever again.

(a) The person at one end of the slinky should "bunch up" some of the slinky longitudinally (along the line of the slinky)



Now let the slinky go.

Observe the longitudinal wave travel along the slinky.

(b) Now the person at one end of the slinky should displace the slinky transversely (to direction of stretched slinky) and let go

observe the TRANSverse wave travel along the Slinky. (might want to make this displacement in the horizontal direction if the slinky is touching the floor.

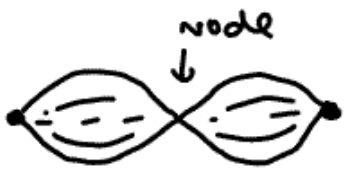
(c) What waves in nature are longitudinal?
TRANSverse?

(d) Have the person at one end of the Slinky move their end up and down smoothly at a fixed frequency.

Can you form STANDing waves with zero "Nodes"

"Fundamental"

one node?



"1ST harmonic"

two nodes?

"2ND harmonic"

Don't try more than 2 nodes.

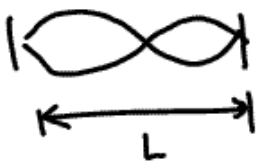
for string (or slinky) of length L, what frequencies (or periods) give STANDING waves? ... A Theoretical analysis

0 nodes

$L = \frac{1}{2}\lambda$ $\quad v = \lambda\nu$

$\lambda = v/\nu$

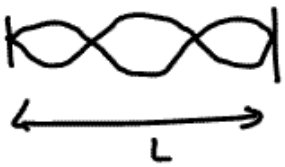
$L = \frac{1}{2}\frac{v}{\nu} \rightsquigarrow \nu = \frac{1}{2}\frac{v}{L}$



1 node

$L = \lambda$ $\quad \nu = \frac{2}{2}\frac{v}{L}$

$L = \frac{v}{\nu}$



2 nodes

$L = \frac{3\lambda}{2}$ $\quad \nu = \frac{3}{2}\frac{v}{L}$

$L = \frac{3}{2}\frac{v}{\nu}$

$\vdots$

$\boxed{\nu_n = \frac{n}{2}\frac{v}{L}}$ frequencies that will resonate on string (or slinky) of length L

$n = 1, 2, 3 \ldots$

$n=1$ corresponds to the fundamental frequency

$n=2$ " " " 1ST harmonic

$n=3$ " " " 2ND "

⋮

V is speed of wave propagation on string

This depends on Tension and mass of string.

This is why pitch changes when you tighten or loosen a string → you change V in the eqn above.

With the materials you have at hand,

design an experiment to

see if the relationship I derived above seems to work for waves on a Slinky.

After discussing your idea with your TA,

carry out your experiment.

(7)

Bundle up and have two members of your group move far away but within sight. Have them make a loud sound by slapping one book into the other.

Assume light travels from your friends to you instantaneously.

determine the speed of sound in air by timing the difference in time between the arrival of the sound and the visible impact of the books.

Before asking your TA for the accepted value for the speed of sound in air, estimate the error in your experimental result.