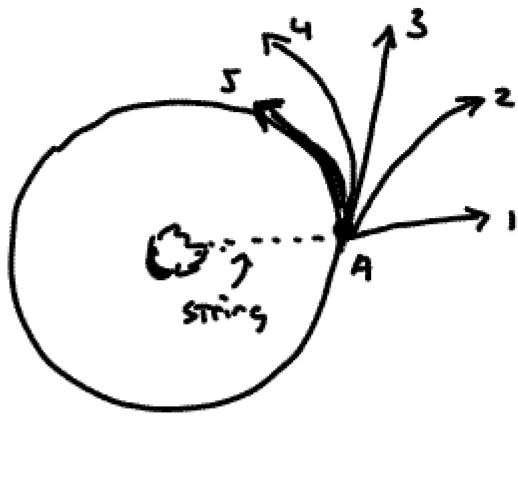
Physics 102 - Fall 2009 - Recitation 4

(1)

A kid twirls a rock attached to a string about his head. The rock moves along a circular path.

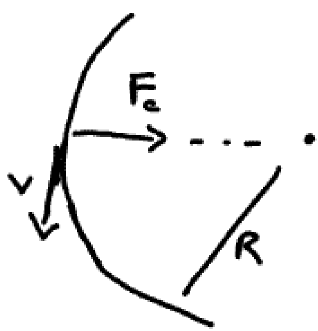
What happens if the string breaks?

Looking from above ... what path will the rock take if the string breaks at point A?



Defend your answer using Newton's Laws.

(2) For an object to move on a circle there must be a net force toward the center of circle, $F_c = mv^2/R$, called the "centripetal force".



The string supplies the centripetal force for the rock in the example above.

What supplies the centripetal force for a speedskater going around a curve?

What supplies the centripetal force for a car going around a curve?

For a given set of road conditions, what happens if you take a curve too fast?

if you take too sharp a curve?

defend your answers using the circular motion equation above.

(3) In the Bohr model of the atom (ask your TA, as needed) what is the force that acts as the centripetal force?

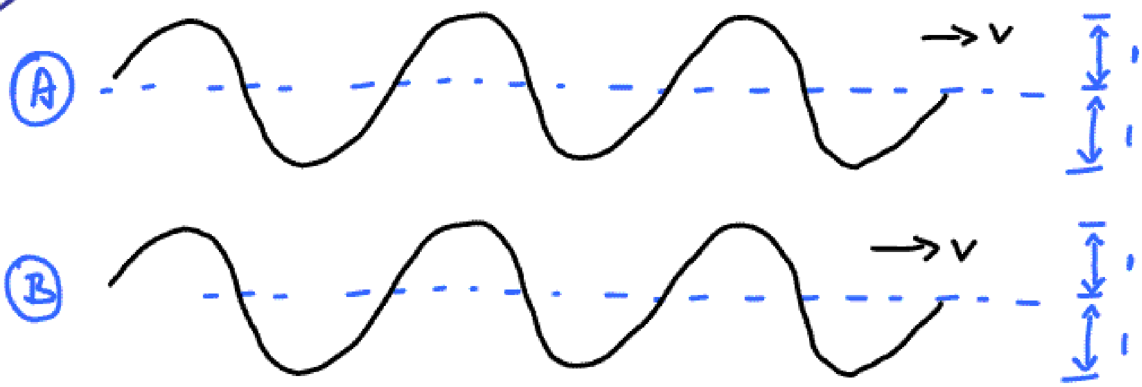
(4) For the space shuttle in orbit, what force acts as the centripetal force?

Are the astronauts on the space shuttle in orbit weightless?

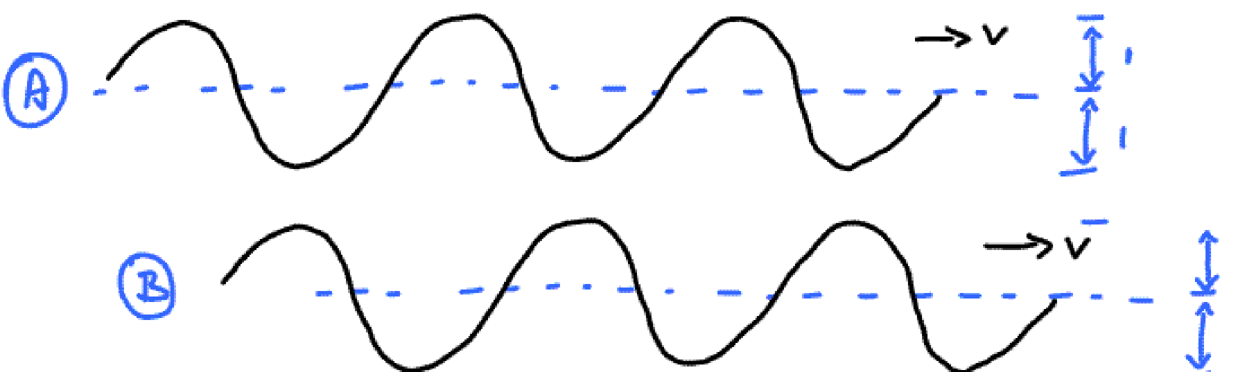
(5) If you were captain of the space shuttle, how would you move to a higher orbit if asked to do so by NASA?

(i.e., in what direction would you fire your rockets?)

6



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

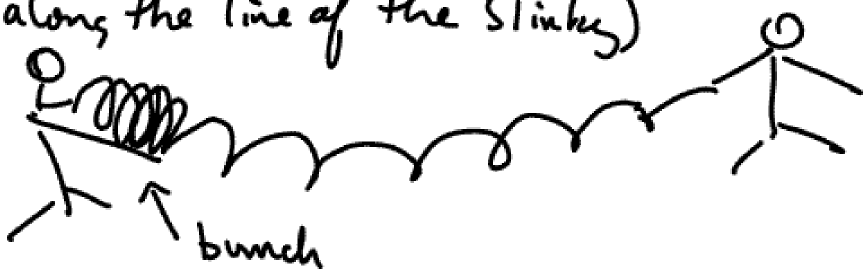


Suppose waves (A) and (B) Travel in space together. How would the wave resulting from wave (A) and (B) interfering appear?

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)



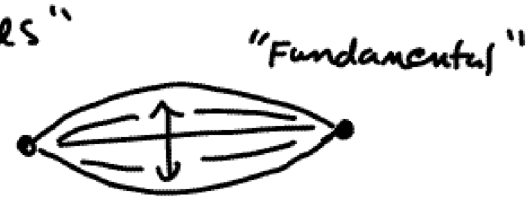
Now let the slinky go.
Observe the longitudinal wave travel along the slinky.

(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 then end up and down smoothly at a fixed frequency.
Can you form STANDING waves
with zero "Nodes"

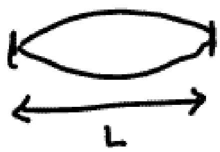


one node?

Two nodes?

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

$L = \frac{1}{2}\lambda$

$v = \lambda \nu$

$\lambda = v/\nu$

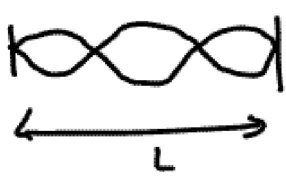
$L = \frac{1}{2}\frac{v}{\nu} \rightsquigarrow \nu = \frac{1}{2}\frac{v}{L}$

1 node

$L = \lambda$

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

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



2 nodes

$L = \frac{3\lambda}{2}$

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

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

⋮

$$\boxed{\nu_n = \frac{n}{2}\frac{v}{L}}$$

frequencies that will resonate on string (or slinky) of length L

$n = 1, 2, 3 \dots$

$n=1$ corresponds to the fundamental frequency
$n=2$ " " " 1^{ST} harmonic
$n=3$ " " " 2^{ND} "
⋮

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.