Physics 122, Sections 0502,3,4 and 8101 **Assignment 7**
Laura Lising **Due April 3, start of class**

Reference: Cutnell & Johnson, 16.1-16.3, 16.5 (beginning waves and sound). And/or see the links on the web pages, to chapters from Prof. Redish's book.

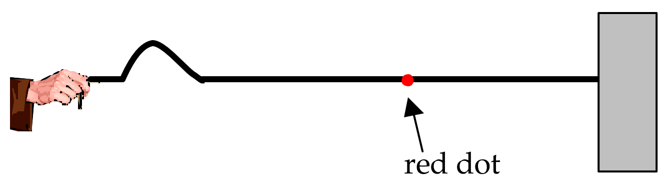
1) Think of two or three different types of waves (at least one should be something not from class.)

   a) For each of these, make a list of things that you think should affect how fast the wave propagates (travels) and a list of things that you think shouldn't affect the propagation speed.

   b) Take the things in these two categories and re-sort them into two different categories, labeled "properties of the disturbance (or the pulse)" and "properties of the medium."

   c) Are the two sets of categories the same? Does looking at list (b) make you want to rethink any thing about your sorting for (a)?

2) A student has a rope tight to a wall, and flicks her wrist to make a small pulse as shown in the figure. The rope has a red dot painted on it. For each of the following, try to come up with a few different ways,

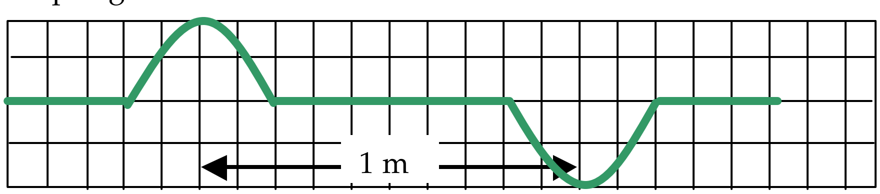


   a) What could she do to make the pulse get to the wall more quickly?

   b) What could she do to make the pulse wider?

   c) What could she do to make the red dot move more quickly?

3) In lecture and tutorial we've talked about the fact that when these two pulses pass each other the spring would become flat.



   a) Explain, in your own words and with a diagram why the waves reappear after the string is flat. (Yes, I gave an explanation in lecture – but I wasn't sure how many people "got it.")

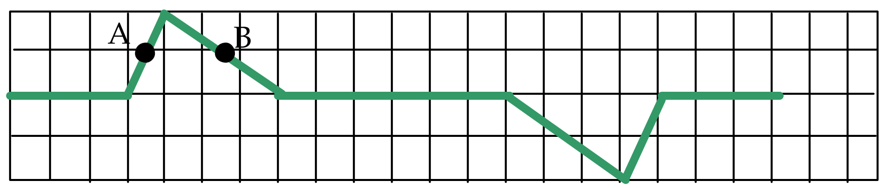
   b) A puzzle to try to reconcile: According to the rule from tutorial and what we said in lecture, the piece of spring right in the middle never moves. But if it never moves, how can the waves go through it? Shouldn't it have to move for the waves to pass by? In fact, if it never moves, it shouldn't change anything if we were to tie it down at that point, and then the waves would *have* to stop there, wouldn't they?

Of course you know that the waves don't stop there, but how do you respond to this thinking?

4) At the time t = 0, a string has the shape shown below. The pulse on the left is moving towards the right and the pulse on the right is moving towards the left. Each box in the grid has side of 1 cm.

   a) The leading edges of the pulses will meet at time t = 0.05 seconds. What is the speed at which each pulse is traveling?

   b) Two points on the string are marked with heavy black dots and with the letters A and B. At the instant shown, what are the velocities of the dots? Give magnitude and direction (up, down, left, right, or some combination of them).



   c) Draw what the string would look like when the two waves are on top of each other — the leading edge of each wave lined up with the trailing edge of the other.

5) In class we found that mass of the bars had an effect of the wave propagation speed. This is also true for a wave pulse on a stretched spring like the ones you used in tutorial. Assuming you can make two springs with different masses but the same stiffness and put them under the same tension, the pulses will travel faster on the lighter one. ("Lighter" means that the spring has a smaller linear mass density, μ, which is the mass per unit length. Thus for the same length of spring, there is less mass.)

   In tutorial we found that the pulse traveled faster if you stretched the spring more, that is, applied more tension. Considering this and your answer to part (a), come up with a formula that relates the wave speed to the mass density, m, and the tension T. (The waves speed formula should give you the units of speed, so if you need to add a constant for units, state this and what the units of that constant are.)

6) Suppose it takes t seconds for me to flick my wrist to make a single pulse on a slinky – that is, suppose the time t goes by from when I start my hand moving to when I stop my hand from moving. And suppose the speed of the wave on the string is v. Write a formula for the length of the wave pulse I make along the string.