

I. Reflection and transmission across a boundary

A. Obtain a heavy (dense) spring and a light spring, hooking them together to make one long spring. Stretch them out and send pulses from one end to another.

In which of the springs do the pulses move faster?

A single initial pulse hits the boundary between the two springs. How many pulses leave the boundary?

Send an initial pulse from the more dense spring to the less dense spring.

The drawing below shows the initial pulse moving with speed v_0 in the dense spring.



On the drawing below, sketch the both the reflected and transmitted pulses. Be sure your drawings indicate correctly the following: side of the spring, speed of the pulses, wavelength and amplitude.



Send an initial pulse from the less dense spring to the more dense spring.

The drawing below shows the initial pulse moving with speed v_0 in the lighter spring.



On the drawing below, sketch the both the reflected and transmitted pulses. Be sure your drawings indicate correctly the following: side of the spring, speed of the pulses, wavelength and amplitude.

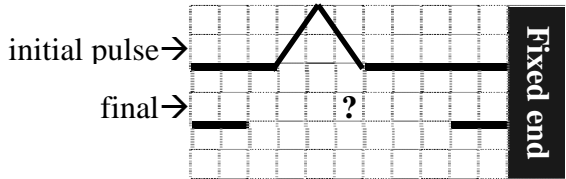


B. The series of diagrams below show a pulse incident from the left on a spring of medium mass density ($\rho = m/L$). The midpoint "Q" shows the *boundary* between the two springs.

Indicate the **amplitude** and **width** of the transmitted and reflected pulses in each case. The incident pulse has pulse width (wavelength) = 3 squares, amplitude = 2 squares.

Note: The 1st, 3rd, and 5th drawings are clear-cut—do these first. The 2nd and 4th drawings are "shades of gray."

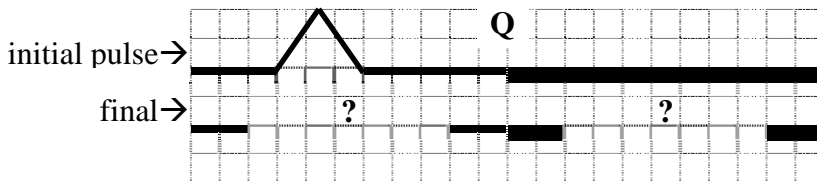
1. the incident pulse hits a **completely fixed end** ("infinitely dense" material)



pulse width T = _____ squares
amplitude T = _____ squares

pulse width R = _____ squares
amplitude R = _____ squares

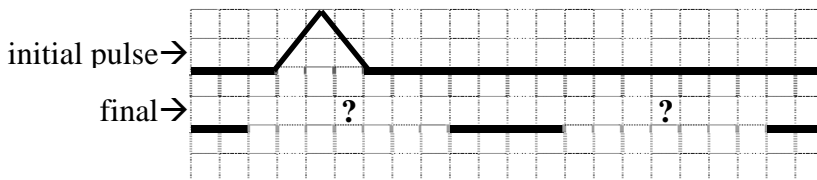
2. the incident pulse hits a **nearly fixed end** (very dense material)



pulse width T = _____ squares
amplitude T = _____ squares

pulse width R = _____ squares
amplitude R = _____ squares

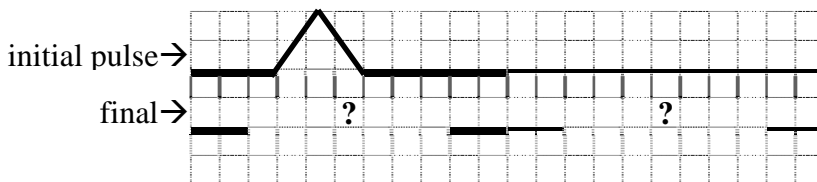
3. the incident pulse hits **the same material** (same density as incident material)



pulse width T = _____ squares
amplitude T = _____ squares

pulse width R = _____ squares
amplitude R = _____ squares

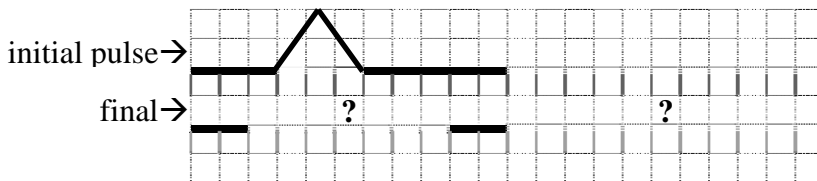
4. the incident pulse hits a **less dense material** than incident



pulse width T = _____ squares
amplitude T = _____ squares

pulse width R = _____ squares
amplitude R = _____ squares

5. the incident pulse hits a **free end** ("zero density" material; remember the cups)

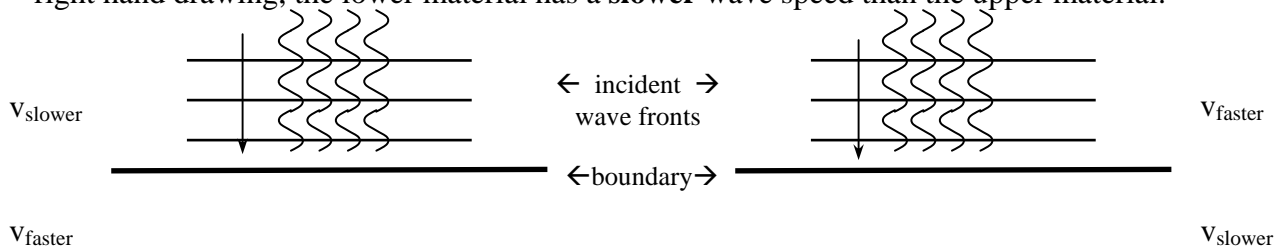


pulse width T = _____ squares
amplitude T = _____ squares

pulse width R = _____ squares
amplitude R = _____ squares

II. Plane waves, boundaries and refraction

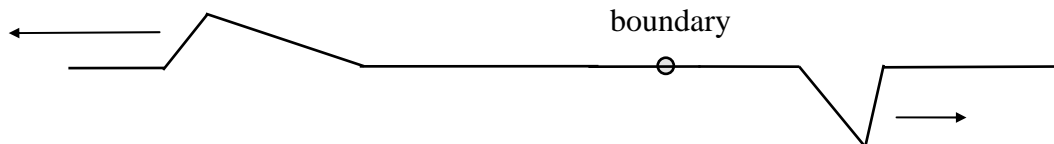
A. The “plane wave” description of waves represents waves without drawing a large number of individual waves. The drawing below shows plane waves incident from above on a boundary. In the left hand drawing, the lower material has a **faster** wave speed than the upper material. In the right hand drawing, the lower material has a **slower** wave speed than the upper material.



On the two drawings above, carefully sketch the plane wave fronts for the *transmitted* waves. Be sure the transmitted wavelength is appropriate for the speed of each lower material.

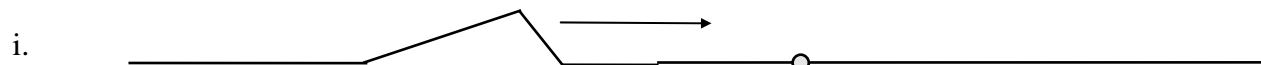
Draw arrows above that show the direction the waves are traveling; the incident arrows have been done for you—you need to draw the travel direction arrows in the lower material.

1. [17 pts] The diagram below shows a reflected and transmitted pulse going about their merry way. These pulses were generated by an incident pulse crossing the boundary (the dot in the figure below) between a steel and a brass spring. The steel spring is more dense than the brass spring. The widths of the lines are the same and do not indicate which side is steel or brass. The arrows are the *velocity vectors* of the pulses.

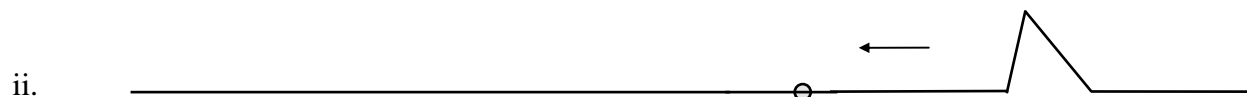


- A. [5pts] Which (i.e., the left-hand one or the right-hand one) is the brass spring and which is the steel spring. Explain your reasoning (no reason = no credit).

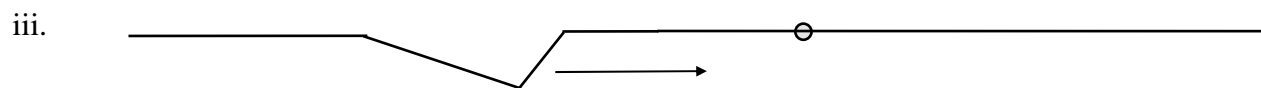
- B. [12 pts] For *each* case below, draw the reflected and transmitted pulses created by the incident pulses shown. Explain why *each* pulse drawn either *could* or *could not* have been the incident pulse that resulted in the situation shown above.



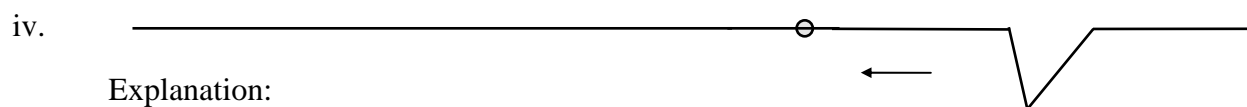
Explanation:



Explanation:



Explanation:



Explanation: