VIII. [20 points total] Shown at right are wavefronts of a periodic wave traveling from the upper medium into the lower medium in Experiment 1.

In Experiment 2, the upper medium is changed so that the wave speed in the upper medium is increased. Neither the lower medium nor the source of the incident waves are changed. Ignore all reflections in this problem.

A. How, if at all, would the above change affect each of the following? Explain your reasoning in each case.

- [4 pts] the spacing of the wavefronts in the upper medium

Since the speed in the upper medium is increased and the frequency is unchanged, the wavelength in the upper medium must increase. Therefore, the spacing of the wavefronts in the upper medium is increased.

- [5 pts] the spacing of the wavefronts in the lower medium

The lower medium is unchanged, therefore, the wave speed in the lower medium is unchanged as well. Since neither the speed nor the frequency in the lower medium is changed, the wavelength in the lower medium remains the same. Thus, the spacing of the wavefronts in the lower medium remains the same.

- [5 pts] the angle $\alpha$ between a wavefront in medium 1 and a wavefront in medium 2, as shown above

The orientation of the wavefronts in the upper medium in Experiment 2 is the same as that in Experiment 1; however, the spacing between the wavefronts is increased. In the lower medium, the spacing between the wavefronts is unchanged in Experiment 2. Therefore, to meet the boundary conditions (namely, for each wavefront in the upper medium there is a wavefront in the lower medium) the angle between the wavefronts must increase.

The top-view diagram at right shows two different springs connected at point J. Student 1 holds the left end of spring 1 and student 2 holds the right end of spring 2. Only one student creates a pulse. A short time later, the spring is observed to have the shape shown at right. Ignore reflections at the students’ hands.

B. [6 pts] Determine which student created the pulse. In the diagram at right, make a qualitatively correct sketch of this pulse just after it is created. (Note: the amplitude of your pulse could be approximate). Explain.

The transmitted pulse is always on the same side of the spring as the incident pulse. Since the two pulses shown are on opposite sides, the reflected pulse must be on the opposite side of the spring with respect to the incident pulse. That suggests that the reflection at point J is more like a fixed-end reflection. Thus the incident pulse traveled from the faster medium to the slower medium. The width of the pulse on Spring 2 is greater than that on Spring 1, so the propagation speed of Spring 2 is greater than that of Spring 1. Thus, student 2 created the incident pulse. The shape of the incident pulse is shown on the diagram above.