Physics 11: Wave Interference - Boundary Behaviour

Use the following devises to demonstrate the following situations of reflection and transmission of waves at a boundary.

- snaky (long slinky) – available in the classroom
- interactive simulation: https://phet.colorado.edu/en/simulation/wave-on-a-string
- simulation: http://www.acs.psu.edu/drussell/Demos/reflect/reflect.html

1. ***Low density to high density boundary:*** Create a wave in a lower density medium, directed toward a higher density medium e.g. one person holds the end of a snaky firmly, mimicking a wall (high density/fixed end), while their partner creates a pulse in the low density/loose end of the snaky. Describe the ***reflected pulse*** in comparison to the incident pulse:
    i. Upright or inverted? _____
    ii. Amplitude – smaller/equal/greater? _____
    iii. Speed – smaller/equal/greater? _____

2. ***High density to low density boundary:*** Create a wave in a high density medium, directed toward a low density medium e.g. one end of the snaky is loosely connected to a metal bar so that it can slide easily (low density), while a pulse is created at the other end (high density). Describe the ***reflected pulse*** in comparison to the incident pulse:
    i. Upright or inverted? _____
    ii. Amplitude – smaller/equal/greater? _____
    iii. Speed – smaller/equal/greater? _____

3. Use the interactive simulation (https://phet.colorado.edu/en/simulation/wave-on-a-string) to demonstrate the situations described in questions 1 and 2. At the bottom, set "damping" to "none", and "tension" to "high".
    i. Try the different settings on the top left – *manual, oscillate, and pulse*. For our purposes, which setting best helps us demonstrate the concept of wave behaviour at a boundary? _____
    ii. Try the different settings on the top right – *fixed end, loose end, and no end*. Does the simulation match the results when using a snaky in the classroom? _____
    iii. Adjust the "damping" setting to a higher value. What effect does increased damping have on the wave? (then, return "damping" to "none" before moving on to the next step). _____
    iv. Adjust the "tension" setting to a lower value. What effect does decreased tension have on the wave? _____

4. Refer to this simulation to observe waves at a boundary where both reflection and transmission take place (scroll down the page to see the relevant simulation): http://www.acs.psu.edu/drussell/Demos/reflect/reflect.html
    a. ***High speed (low density) to low speed (high density) medium:***
        i. Describe the ***transmitted pulse*** in comparison to the incident pulse:
            1. Upright or inverted? _____
            2. Amplitude – smaller/equal/greater? _____
            3. Speed – smaller/equal/greater? _____
            4. Width of the pulse (wavelength) _____
            5. Frequency of the pulse _____

        ii. Describe the ***reflected pulse*** in comparison to the incident pulse:
            1. Upright or inverted? _____
            2. Amplitude – smaller/equal/greater? _____
            3. Speed – smaller/equal/greater? _____
            4. Width of the pulse (wavelength) _____
            5. Frequency of the pulse _____

    b. ***Low speed (high density) to high speed (low density) medium:***
        i. Describe the ***transmitted pulse*** in comparison to the incident pulse:
            1. Upright or inverted? _____
            2. Amplitude – smaller/equal/greater? _____
            3. Speed – smaller/equal/greater? _____

        ii. Describe the ***reflected pulse*** in comparison to the incident pulse:
            1. Upright or inverted? _____
            2. Amplitude – smaller/equal/greater? _____
            3. Speed – smaller/equal/greater? _____

    c. What factor do you think determines the relative amplitudes of the transmitted and reflected pulses?

    d. What factor determines the frequency of the incident, reflected, and transmitted pulse (wave)