

## Boundary Behavior

Read from **Lesson 3** of the **Waves** chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/waves/u10l3a.html>

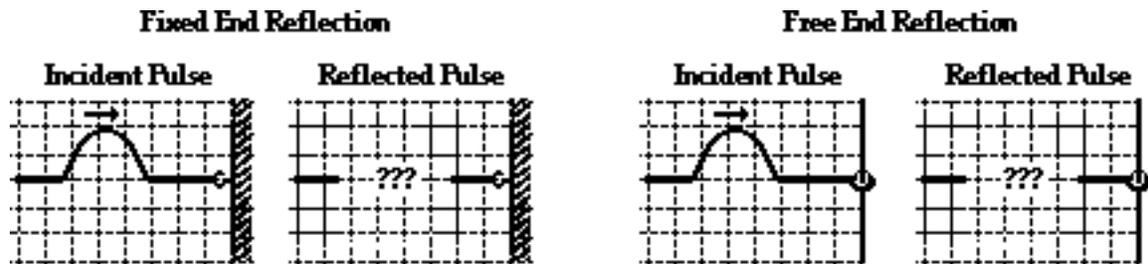
**MOP Connection:** Waves: sublevel 5

### Background:

The behavior of a traveling wave (or pulse) upon reaching the end of a medium is referred to as **boundary behavior**. When one medium ends, another medium begins; the interface of the two media is referred to as the **boundary** and the behavior of a wave at that boundary is described as its boundary behavior. A pulse that is approaching a boundary is referred to as the **incident pulse**. Upon reaching the boundary, a portion of the incident pulse will be reflected and remain in the same medium; and a portion of the incident pulse will pass into (or be transmitted into) the other medium which lies beyond the boundary. The portion of the pulse that is reflected is referred to as the **reflected pulse** and the portion that passes into the other medium is referred to as the **transmitted pulse**. A proper understanding of the boundary behavior of waves involves an ability to answer the following questions.

### Fixed and Free End Reflection:

1. State the rule that describes how a pulse will behave at a free- and a fixed-end.
2. Express your understanding of reflection of waves at the end of a medium by drawing the size and orientation of the reflected pulse for the two cases below - reflection off a free end and a fixed end.



### Reflection and Transmission of an Incident Pulse at a Boundary Between Two Media:

A pulse is moving from a more dense medium to a less dense medium as shown in the diagram below.



3. The reflected pulse in medium 1 \_\_\_\_\_ (will, will not) be inverted because \_\_\_\_\_.
4. The speed of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.
5. The speed of the reflected pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.
6. The wavelength of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the wavelength of the incident pulse.

## Wave Basics

A pulse is moving from a less dense medium to a more dense medium as shown in the diagram below.



7. The reflected pulse in medium 2 \_\_\_\_\_ (will, will not) be inverted because \_\_\_\_\_

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8. The speed of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.
9. The speed of the reflected pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.
10. The wavelength of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the wavelength of the incident pulse.

11. Summarize your understanding of boundary behavior by completing the following statements.

When a wave passes across the boundary from one medium to another medium, the ...

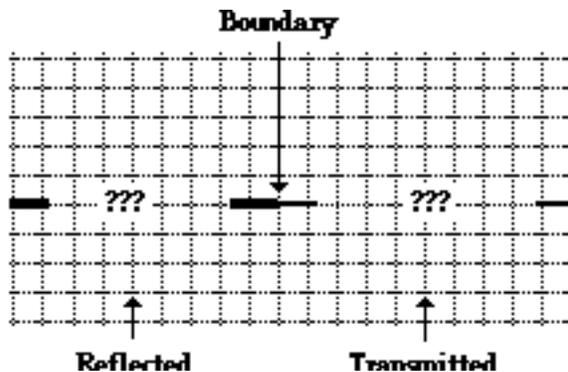
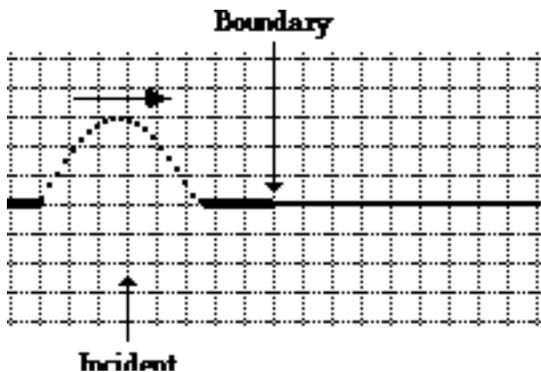
... speed is \_\_\_\_\_ (greatest, smallest) in the least dense media.

... wavelength is \_\_\_\_\_ (greatest, smallest) in the least dense media.

... the reflected pulse becomes inverted only when the incident wave is in the \_\_\_\_\_ (more, less) dense medium and heading toward the \_\_\_\_\_ (more, less) dense medium.

Express your understanding of the rules of boundary behavior by drawing the reflected and transmitted pulses in the following two situations. Show the orientation (inverted or non-inverted, wavelength and speed) of each pulse.

12. Incident pulse is in the more dense medium and traveling toward the less dense medium.



13. Incident pulse is in the less dense medium and traveling toward the more dense medium.

