WAVES, SOUND & PHYSICAL OPTICS DAY 3: BOUNDARY BEHAVIOR AND POLARIZATION

CED 14.3 · Skill 3.B · FRQ: Qualitative/Quantitative Translation

PREDICT

An upright pulse reaches a rope end tied firmly to a wall. The reflected pulse returns:

A. upright **B. inverted** **C. twice as tall** **D. not at all**

Commit before the reflected pulse is shown.

REFLECTION AT AN END

Fixed end: the endpoint cannot move, so the reflected pulse is inverted.
Free end: the endpoint can move, so the reflected pulse remains upright.

NOTES / REASONING

A CHANGE OF MEDIUM

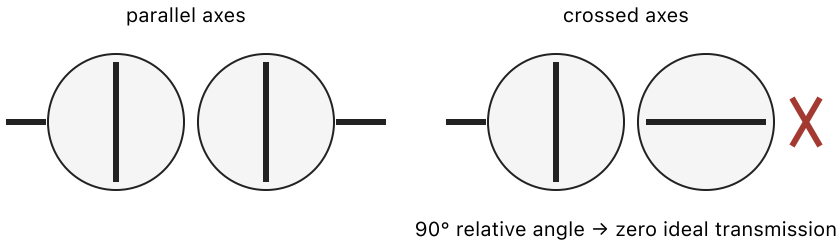
At a boundary between media, a pulse can split. Part is reflected and part is transmitted. The speeds generally differ because the media differ; frequency remains set by the source.

1. Draw an upright incident pulse, an inverted reflected pulse, and an upright transmitted pulse at a boundary where reflection inverts.

2. The transmitted wave moves more slowly but has the same frequency. Predict its wavelength and justify with $v = f\lambda$.

POLARIZATION

RELATIVE TRANSMISSION AXES



A polarizer selects one transverse field direction. Ideal parallel axes transmit the selected component; ideal crossed axes transmit no light.

$$I = I_0 \cos^2 \theta$$

Here I_0 is the intensity of already-polarized light reaching the analyzer.

Light with $I_0 = 80\,\mathrm{W/m^2}$ reaches an analyzer at 60°. Find the transmitted intensity.

USE THE REPRESENTATIONS

1. Sketch the reflected pulse from a free end and state whether it is inverted.

2. Two ideal polarizers have axes 90° apart. Find the transmitted fraction.

3. Explain why a transverse rope wave can be polarized but a longitudinal sound wave cannot.

4. A student says the wall supplies negative energy to flip the pulse. Give a boundary-condition explanation.