Polarization

- Linearly ________ light ________ in only ________ direction
- Common non-__________ light vibrates in ________ directions perpendicular to the ________ of travel.

How to make EM waves polarized

- Straight wire ________
- ________ of ________ surfaces
- Passing through a polarizing ________

Polarizing materials

- Light is ________ along the transmission ________
- All ________ of the wave are ________ except the components ________ to the ________ axis
- Since unpolarized light vibrates ________ in ________ directions, the polarizing material absorbs ________ the light.

\[ I = \frac{1}{2} I_0 \]

Malus’s Law

- After light has been polarized a ________ polarizer can be used to ________ the ________ of the transmitted light.
- Polarizer ________ the light. The analyzer ________ the polarized light along another _________. It only transmits the component ________ to the transmission axis of the _________.

\[ I = I_0 \cos^2 \theta \]

A certain camera lens uses two polarizing filters to decrease the intensity of light entering the camera. If the light intensity in the scene is 20 W/m², what is the intensity of the light between the two filters?

If the light intensity at the film is 3 W/m², what is angle between the transmission axes of the polarizers?
Polarization by Reflection

- Light polarized perpendicular to ________ is more likely ____________
- Light ____________ to surface is more likely ____________
- Light is ____________ polarized at ____________ Angle
  \[ \tan \theta_b = \frac{n_2}{n_1} \]
- Where \( \theta_b \) = Brewster’s angle and \( n_1 \) and \( n_2 \) are indices of refraction

Homework

1. Can a sound wave in air be polarized? Explain.
2. No light passes through two perfect polarizing filters with perpendicular axes. However, if a third polarizing filter is placed between the original two, some light can pass. Why is this? Under what circumstances does most of the light pass?
3. The angle between the axes of two polarizing filters is 45.0°. By how much does the second filter reduce the intensity of the light coming through the first? (OpenStax 27.85) \( 0.500 \)
4. If you have completely polarized light of intensity 150 W/m\(^2\), what will its intensity be after passing through a polarizing filter with its axis at an 89.0° angle to the light’s polarization direction? (OpenStax 27.86) \( 4.57 \times 10^{-2} \) W/m\(^2\)
5. What angle would the axis of a polarizing filter need to make with the direction of polarized light of intensity 1.00 kW/m\(^2\) to reduce the intensity to 10.0 W/m\(^2\)? (OpenStax 27.87) \( 84.3° \)
6. Verify that the intensity of polarized light is reduced to 90.0% of its original value by passing through a polarizing filter with its axis at an angle of 18.4° to the direction of polarization. (OpenStax 27.88) \( 90.0\% \)
7. At what angle will light reflected from diamond be completely polarized? (OpenStax 27.91) \( 67.6° \)
8. What is Brewster’s angle for light traveling in water that is reflected from crown glass? (OpenStax 27.92) \( 48.8° \)
9. A scuba diver sees light reflected from the water’s surface. At what angle will this light be completely polarized? (OpenStax 27.93) \( 53.1° \)