Name: _____

Polarization

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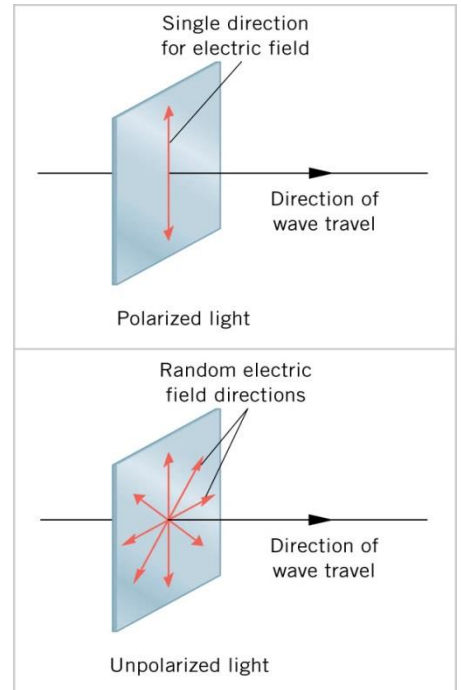- Common non-_____ light vibrates in _____ directions perpendicular to the _____ of travel.

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.

$$I = \frac{1}{2}I_0$$

Single direction for electric field

Polarized light

Random electric field directions

Direction of wave travel

Unpolarized light

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 _____.

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

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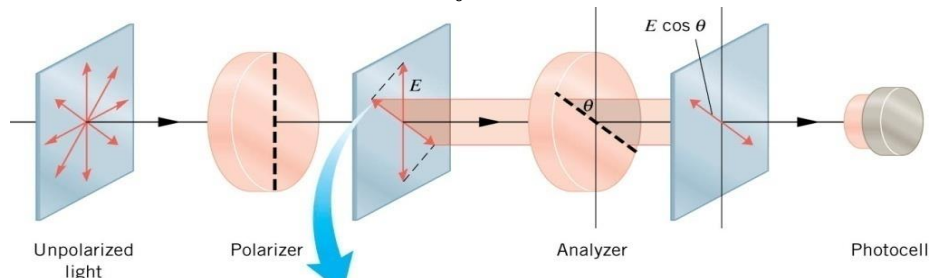
A certain camera lens uses two polarizing filters to decrease the intensity of light entering the camera. If the light intensity in the scene is 20 W/m², what is the intensity of the light between the two filters?

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 θ_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/m², 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) $\mathbf{4.57 \times 10^{-2}}$ **W/m²**

5. What angle would the axis of a polarizing filter need to make with the direction of polarized light of intensity 1.00 kW/m² to reduce the intensity to 10.0 W/m²? (OpenStax 27.87) $\mathbf{84.3°}$

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) $\mathbf{67.6°}$

8. What is Brewster's angle for light traveling in water that is reflected from crown glass? (OpenStax 27.92) $\mathbf{48.8°}$

9. A scuba diver sees light reflected from the water's surface. At what angle will this light be completely polarized? (OpenStax 27.93) $\mathbf{53.1°}$