

Worksheet: Polarization of Electromagnetic Radiation



Q1: If a polarizing filter reduces the intensity of polarized light to 50.0% of its original value, what is the ratio of the amplitude of the electric and magnetic fields in the light incident from and emergent from the filter?



Question Video

A 1 : 0.667

B 1 : 0.500

C 1 : 0.354

D 1 : 0.707

E 1 : 0.250

Q2: 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?

A 0.707

B 0.500

C 0.354

D 0.250

E 0.125

Q3: Two polarizing sheets are placed together to form a combination with transmission axes of the polarizers oriented at an angle θ to each other. With the polarizers so aligned, the amount of light that passes through the sheets is 25.0% of the maximum possible intensity of plane polarized light that the combination can transmit. What percentage of unpolarized light would be transmitted through the combination?

A 15.9%

B 17.7%

C 8.86%

D 6.25%

E 12.5%

Q4: 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 ?

A 68.3°

B 73.7°

C 84.3°

D 78.1°

E 70.8°

Q5: The light incident on polarizing sheet P_1 is linearly polarized at an angle of 30.0° with respect to the transmission axis of P_1 . Sheet P_2 is placed so that its axis is parallel to the polarization axis of the incident light.

► What fraction of the incident light passes through P_1 ?

A 0.667

B 0.717

C 0.750

D 0.686

E 0.630

► What fraction of the incident light is passed by the combination?

A 0.591

B 0.503

C 0.563

D 0.535

E 0.616

► P_2 is rotated so as to produce a maximum value of intensity transmitted by the combination. What is the ratio of the maximum transmitted intensity to the transmitted intensity before P_2 was rotated?

- A 1.46
- B 1.28
- C 1.33
- D 1.40
- E 1.52

Q6: A student places sheets P_1 and P_2 so that their transmission axes are at 45.0° and 90.0° , respectively. These angles are relative to the axis of polarization of a beam of linearly polarized light. This rotates the beam's polarization by 90.0° .

► What fraction of light passes through P_1 ?

- A 0.450
- B 0.354
- C 0.500
- D 0.707
- E 0.250

► What fraction of light passes through both sheets?

A 0.333

B 0.177

C 0.250

D 0.354

E 0.125

► The transmission angle for P_1 is changed to 30.0° relative to the beam's polarization axis. After the angle change, what fraction of light passes through both sheets?

A 0.160

B 0.150

C 0.187

D 0.177

E 0.133

Q7: At what angle is light inside crown glass (refractive index 1.52) completely polarized when reflected from water (refractive index 1.333), as in a fish tank?

A 41.2°

B 42.0°

C 40.3°

D 40.9°

E 41.8°

Q8: At what angle will light reflected from diamond into air be completely polarized? Use a value of 2.419 for the refractive index of diamond.

A 67.54°

B 60.24°

C 63.53°

D 66.03°

E 69.10°

Q9: A scuba diver sees light reflected from the surface of water (refractive index of 1.33) above which is air (refractive index of 1.00). At what angle will this light be completely polarized?

- A 54.2°
- B 55.0°
- C 53.1°
- D 52.6°
- E 53.7°

Q10: Light reflected at an angle of 62.5° from a gemstone in a ring into air is completely polarized.

► What is the gem's refractive index?

- A 1.87
- B 1.92
- C 1.98
- D 2.03
- E 2.07

► At what angle would the light reflected from the gem be completely polarized if the gem was underwater? Use a value of 1.33 for the refractive index of water.

A 56.1°

B 55.2°

C 56.9°

D 57.7°

E 58.5°

Q11: On a day when the intensity of sunlight is 1.00 kW/m^2 , a circular lens 0.2000 m in diameter focuses light onto water in a black aluminum beaker. Two polarizing sheets of plastic are placed in front of the lens with their axes at an angle of 20.0° to each other. The aluminum beaker has a mass of 30.0 grams and contains 250 grams of water. Assuming the sunlight is unpolarized and the polarizers are 100% efficient, what is the initial rate of heating of the water, assuming an 80.0% absorption of the light by the water? Use a value of $4180 \text{ J/kg}\cdot^\circ\text{C}$ for the specific heat capacity of water and a value of $921 \text{ J/kg}\cdot^\circ\text{C}$ for the specific heat capacity of aluminum.

A $1.69 \times 10^{-2} \text{ }^\circ\text{C/s}$

B $1.47 \times 10^{-2} \text{ }^\circ\text{C/s}$

C $1.35 \times 10^{-2} \text{ }^\circ\text{C/s}$

D $1.58 \times 10^{-2} \text{ }^\circ\text{C/s}$

E $1.24 \times 10^{-2} \text{ }^\circ\text{C/s}$

Q12: Three polarizing sheets are placed parallel to each other. The transmission axis of the second sheet is oriented at 27.8° relative to the transmission axis of the first sheet, and the transmission axis of the third sheet is oriented at 36.7° relative to the transmission axis of the first sheet. What fraction of the intensity of an unpolarized light beam incident on the first sheet is transmitted by the third sheet?

A 0.296

B 0.677

C 0.764

D 0.535

E 0.533

Q13: It is found that when light traveling in water is incident on the surface of a plastic block, Brewster's angle is 52.0° . Find the refractive index of the plastic. Use a value of 1.33 for the refractive index of water.

A 1.70

B 1.53

C 1.73

D 1.63

E 1.68

Q14: Light reflected at 58.2° from a window is completely polarized. What is the window's refractive index?

A 1.37

B 2.00

C 1.53

D 1.65

E 1.61

Q15: Suppose you put on two pairs of polarizing sunglasses with their transmission axes at an angle of 13.7° relative to each other. How much longer will it take sunlight to deposit a given amount of energy in your eye compared with a single pair of sunglasses? Assume the lenses are clear except for their polarizing characteristics.

A 0.653 s

B 0.836 s

C 0.944 s

D 0.533 s

E 0.720 s

Q16: At what angle between the polarization axis of plane polarized light and the axis of a polarizing filter is the intensity of the light transmitted by the filter equal to one-fourth of the intensity of the light incident on the filter?

A 36°

B 45°

C 60°

D 23°

E 17°

Q17: Two polarizing sheets P_1 and P_2 are placed parallel to each other with their transmission axes oriented at an angle θ relative to each other. What is θ when the intensity of light transmitted through P_2 is equal to 33% of the intensity of unpolarized light incident on P_1 ?

A 60°

B 36°

C 17°

D 55°

E 29°

Q18: A ray of unpolarized light propagates in water. The light ray is incident on a plane layer of diamond, and the light ray reflected from the water-diamond interface is completely polarized. Find the angle of reflection of the polarized ray. Use a value of 1.33 for the refractive index of water, and use a value of 2.419 for the refractive index of diamond.

A 35.5°

B 61.2°

C 28.8°

D 51.3°

E 45.0°