

34. In this case, we replace $I_0 \cos^2 70^\circ$ by $\frac{1}{2} I_0$ as the intensity of the light after passing through the first polarizer. Therefore,

$$I_f = \frac{1}{2} I_0 \cos^2 (90^\circ - 70^\circ) = \frac{1}{2} (43 \text{ W/m}^2) (\cos^2 20^\circ) = 19 \text{ W/m}^2.$$

36. (a) The fraction of light that is transmitted by the glasses is

$$\frac{I_f}{I_0} = \frac{E_f^2}{E_0^2} = \frac{E_v^2}{E_v^2 + E_h^2} = \frac{E_v^2}{E_v^2 + (2.3E_v)^2} = 0.16.$$

(b) Since now the horizontal component of \vec{E} will pass through the glasses,

$$\frac{I_f}{I_0} = \frac{E_h^2}{E_v^2 + E_h^2} = \frac{(2.3E_v)^2}{E_v^2 + (2.3E_v)^2} = 0.84.$$

41. As the polarized beam of intensity I_0 passes the first polarizer, its intensity is reduced to $I_0 \cos^2 \theta$. After passing through the second polarizer, which makes a 90° angle with the first filter, the intensity is

$$I = (I_0 \cos^2 \theta) \sin^2 \theta = I_0 / 10$$

which implies $\sin^2 \theta \cos^2 \theta = 1/10$, or $\sin \theta \cos \theta = \sin 2\theta / 2 = 1/\sqrt{10}$. This leads to $\theta = 70^\circ$ or 20° .

43. Let I_0 be the intensity of the incident beam and f be the fraction that is polarized. Thus, the intensity of the polarized portion is $f I_0$. After transmission, this portion contributes $f I_0 \cos^2 \theta$ to the intensity of the transmitted beam. Here θ is the angle between the direction of polarization of the radiation and the polarizing direction of the filter. The intensity of the unpolarized portion of the incident beam is $(1-f)I_0$ and after transmission, this portion contributes $(1-f)I_0/2$ to the transmitted intensity. Consequently, the transmitted intensity is

$$I = f I_0 \cos^2 \theta + \frac{1}{2} (1-f) I_0.$$

As the filter is rotated, $\cos^2 \theta$ varies from a minimum of 0 to a maximum of 1, so the transmitted intensity varies from a minimum of

$$I_{\min} = \frac{1}{2} (1-f) I_0$$

to a maximum of

$$I_{\max} = fI_0 + \frac{1}{2}(1-f)I_0 = \frac{1}{2}(1+f)I_0.$$

The ratio of I_{\max} to I_{\min} is

$$\frac{I_{\max}}{I_{\min}} = \frac{1+f}{1-f}.$$

Setting the ratio equal to 5.0 and solving for f , we get $f = 0.67$.