24.8 We are looking for angles with little or no wave action in a situation with two slits:
interference minima.

\[ d \sin \theta = (m + \frac{1}{2}) \lambda \]  

interference condition

\[ d = 5.0 \text{ cm} \quad \lambda = 2.5 \text{ cm} \quad \frac{\lambda}{d} = 0.5 \]

First minimum: \( m = 0 \)

\[ \sin \theta = (0 + \frac{1}{2}) \frac{2.5 \text{ cm}}{5.0 \text{ cm}} \]

\[ \theta = 14.5^\circ \]

Second minimum: \( m = 1 \)

\[ \sin \theta = (1 + \frac{1}{2}) \frac{2.5 \text{ cm}}{5.0 \text{ cm}} \]

\[ \theta_2 = 48.6^\circ \]

Third minimum: \( m = 2 \)

\[ \sin \theta = (2 + \frac{1}{2}) \frac{2.5 \text{ cm}}{5.0 \text{ cm}} \]

\[ \sin \theta = 1.25 \]

No solution for \( \theta \)

24.116 The red and blue beams can be treated separately.
Reading the plot on p. 672, \( n_{\text{blue}} = 1.64 \), \( n_{\text{red}} = 1.62 \)

Blue:

\[ \theta_1 = 45.0^\circ \quad n \sin \theta_1 = n_x \sin \theta_x \]

\[ 1.0 \sin 45^\circ = 1.64 \sin \theta_x \]

\[ \theta_x = 25.6^\circ \]

\[ 90 - \theta_2 + 60 + 90 - \theta_3 = 180 \]

\[ \theta_3 = 34.5^\circ \]

\[ n_x \sin \theta_3 = n_4 \sin \theta_4 \]

\[ \theta_4 = 68.1^\circ \quad \text{"} \theta_x \text{"} \]
Red:
\[ \theta_1 = 45.0^\circ \]
\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]
\[ 1.0 \sin 45^\circ = 1.62 \sin \theta_2 \]
\[ \theta_2 = 25.9^\circ \]
\[ 90 - \theta_2 + 90 - \theta_3 + 60 = 180 \]
\[ \theta_3 = 34.1^\circ \]
\[ n_3 \sin \theta_3 = n_4 \sin \theta_4 \]
\[ \frac{\theta_4}{10} = 65.3^\circ \]
\[ \theta_0^\circ \]

24.26 For a given \( \lambda \), what is \( D_{\text{max}} \) so that there are no minima from diffraction?

First diffraction minimum:
\[ D \sin \theta = m \lambda = (1) \lambda \]
\[ \sin \theta = \frac{\lambda}{D} \]

In order to see no minima, \( \theta \geq 90^\circ \)
\[ \sin \theta = 1 = \frac{\lambda}{D} \]
\[ D_{\text{max}} = \lambda \]
24.53 At the first polarizer, the unpolarized light loses 50% of its intensity and takes on the first filter’s polarization.

At the second filter, the intensity is reduced by
\[ \cos^2 65^\circ = 0.179 \text{ transmitted} \]

\[ I_0 = 2I_1 \]
\[ I_2 = 0.179I_1 \]
\[ I_2 = 0.0893I_0 \]

24.58 At the first filter, the intensity is reduced by \( \cos^2 \theta \), where \( \theta \) is the angle between the incident polarization \( P_0 \) and the filter polarization \( P_1 \). At the second filter, the reduction is to \( \cos^2 46^\circ = 0.587 \).

\[ I_1 = I_0 \cos^2 \theta \]
\[ I_2 = I_1 \cos^2 46^\circ = I_1 (0.587) \]
\[ I_2 = I_0 \cos^2 \theta (0.587) \]

\( \frac{I_2}{I_0} = 0.15 = \cos^2 \theta (0.587) \)

\[ \theta = 59.6^\circ \]