Chapter 34

Problem 43

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]

If \( n_1 \) is the refractive index of vacuum, then \( n_1 = 1 \). Hence, for the glass

\[ n_2 = \frac{n_1 \sin \theta_1}{\sin \theta_2} = \frac{1 \times \sin 32^\circ}{\sin 21^\circ} = 1.48 \]

Problem 45

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure45.png}
\end{figure}

From the law of refraction:

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]

where \( \theta_1 = \arctan(110/85) = 52.31^\circ \), \( \theta_2 = 90^\circ \) and \( n_2 = 1 \) (refractive index of air). So, the refractive index of the liquid is:

\[ n_1 = \frac{1}{\sin(52.31^\circ)} = 1.26 \]

Problem 55

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure55.png}
\end{figure}

Incident light
**Part a**

If the refractive index of air is $n_a = 1$. Then

$$\sin \theta_c = \frac{n_a}{n} = \frac{1}{1.52} = 0.658$$

Hence, $\theta_c = 41.14^\circ$. From the geometry shown above one can see that $\phi = 90^\circ - \theta_c = 48.86^\circ$.

**Part b**

The computation of part (a) is repeated using the refractive index of water instead of air. The refractive index of water is $n_w = 1.33$. Hence,

$$\sin \theta_c = \frac{n_w}{n} = \frac{1.33}{1.52} = 0.875$$

This gives $\theta_c = 61.04^\circ$. Then it follows that $\phi = 90^\circ - \theta_c = 28.96^\circ$. 