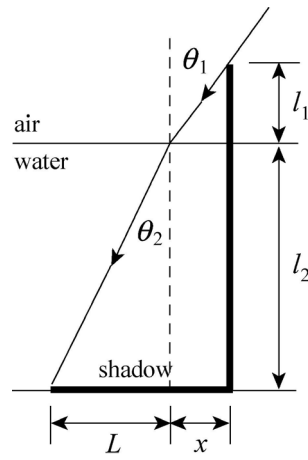


49. Consider a ray that grazes the top of the pole, as shown in the diagram that follows.



Here $\theta_1 = 90^\circ - \theta = 35^\circ$, $l_1 = 0.50$ m, and $l_2 = 1.50$ m. The length of the shadow is $x + L$. x is given by

$$x = l_1 \tan \theta_1 = (0.50 \text{ m}) \tan 35^\circ = 0.35 \text{ m}.$$

According to the law of refraction, $n_2 \sin \theta_2 = n_1 \sin \theta_1$. We take $n_1 = 1$ and $n_2 = 1.33$ (from Table 33-1). Then,

$$\theta_2 = \sin^{-1} \left(\frac{\sin \theta_1}{n_2} \right) = \sin^{-1} \left(\frac{\sin 35.0^\circ}{1.33} \right) = 25.55^\circ.$$

L is given by

$$L = l_2 \tan \theta_2 = (1.50 \text{ m}) \tan 25.55^\circ = 0.72 \text{ m}.$$

The length of the shadow is $0.35 \text{ m} + 0.72 \text{ m} = 1.07 \text{ m}$.