8.19 The two prisms in Fig. P8.19 are made of glass with $n = 1.5$. What fraction of the power density carried by the ray incident upon the top prism emerges from the bottom prism? Neglect multiple internal reflections.

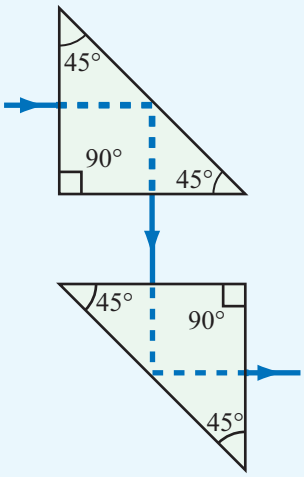

Figure P8.19 Periscope prisms of Problem 8.19.

Solution: Using $\eta = \eta_0/n$, at interfaces 1 and 4,

$$\Gamma_a = \frac{n_1 - n_2}{n_1 + n_2} = \frac{1 - 1.5}{1 + 1.5} = -0.2.$$

At interfaces 3 and 6,

$$\Gamma_b = -\Gamma_a = 0.2.$$

At interfaces 2 and 5,

$$\theta_c = \sin^{-1}\left(\frac{1}{n}\right) = \sin^{-1}\left(\frac{1}{1.5}\right) = 41.81°.$$

Hence, total internal reflection takes place at those interfaces. At interfaces 1, 3, 4 and 6, the ratio of power density transmitted to that incident is $(1 - \Gamma^2)$. Hence,

$$\frac{S^t}{S^i} = (1 - \Gamma^2)^4 = (1 - (0.2)^2)^4 = 0.85.$$