Problem 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.

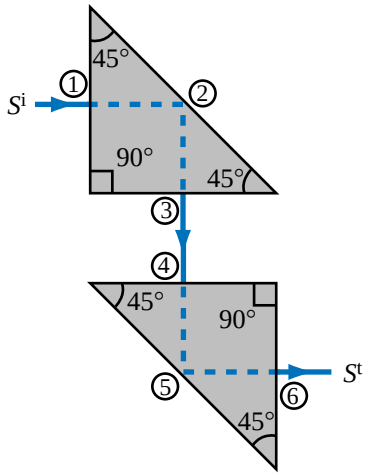

Figure P8.19: Periscope prisms of Problem 8.19.

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,

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

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,

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