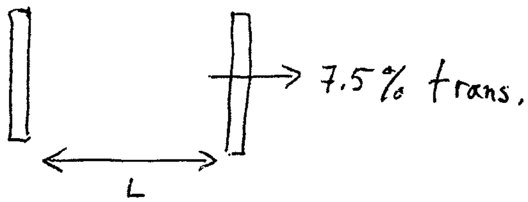
Solution



a) Saturated gain must balance loss in cavity

$$\therefore \quad e^{\gamma_s L} \cdot (0.98)(0.925) = 1$$

$$\text{or} \quad \gamma_s = -\frac{(\ln(0.98) + \ln(0.925))}{L} = 0.196 \text{ m}^{-1}$$

b)

$$\gamma_s = \frac{\gamma_0}{1 + \frac{I}{I_s}}$$

$$\Rightarrow \quad I = \left(\frac{\gamma_0}{\gamma_s} - 1\right) I_s = 15.6 \text{ W/cm}^2$$

c)

$$P_{out} = (I)(T)(A)$$

$$= (15.6)(0.075)\pi(0.25)^2 = 230 \text{ mW}$$

d) Beam waist occurs at flat mirror in a stable cavity. The size of this beam can be characterized by its Rayleigh range and its wavelength. However, we do not need to know the wavelength to calculate the ROC at the back mirror, viz.

$$R(z = z_L) = z_L\left(1 + \frac{z_0^2}{z_L^2}\right) = \frac{3}{4}\left(1 + \frac{1}{(\frac{3}{4})^2}\right) = \frac{25}{12} \text{ m}$$

e)

$$R(z = z_0) = z_0\left(1 + \frac{z_0^2}{z_0^2}\right) = 2z_0 = 2 \text{ meters}$$