

Problem 9.17 Repeat parts (a)–(c) of Problem 9.15 for a dipole of length $l = \lambda$.

Solution: For $l = \lambda$, Eq. (9.56) becomes

$$S(\theta) = \frac{15I_0^2}{\pi R^2} \left[\frac{\cos(\pi \cos \theta) - \cos(\pi)}{\sin \theta} \right]^2 = \frac{15I_0^2}{\pi R^2} \left[\frac{\cos(\pi \cos \theta) + 1}{\sin \theta} \right]^2.$$

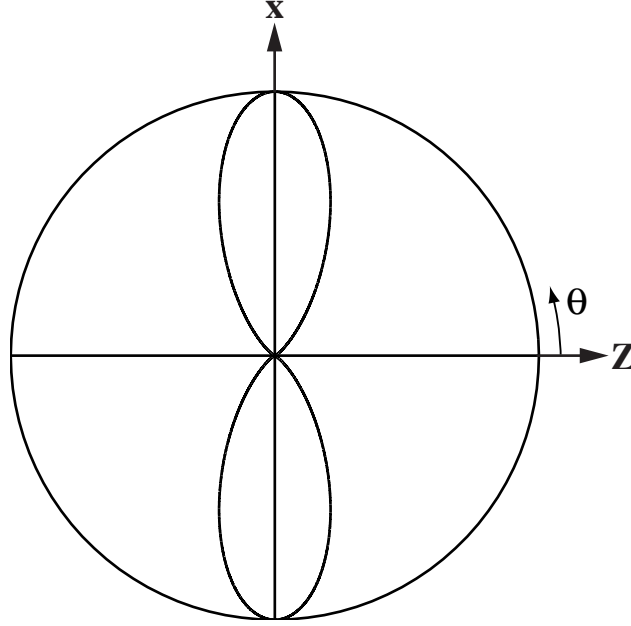


Figure P9.17: Radiation pattern of dipole of length $l = \lambda$.

Solving for the directions of maximum radiation numerically yields

$$\theta_{\max_1} = 90^\circ, \quad \theta_{\max_2} = 270^\circ.$$

(b) From the numerical results, it was found that $S(\theta) = 15I_0^2/(\pi R^2)(4)$ at θ_{\max} . Thus,

$$S_{\max} = \frac{60I_0^2}{\pi R^2}.$$

(c) The normalized radiation pattern is given by Eq. (9.13), as

$$F(\theta) = \frac{S(\theta)}{S_{\max}}.$$

Using the expression for $S(\theta)$ from part (a) with the value of S_{\max} found in part (b),

$$F(\theta) = \frac{1}{4} \left[\frac{\cos(\pi \cos \theta) + 1}{\sin \theta} \right]^2.$$

The normalized radiation pattern is shown in Fig. P9.17.
