

**Problem 9.16** Repeat parts (a)–(c) of Problem 9.15 for a dipole of length  $l = 3\lambda/4$ .

**Solution:**

(a) For  $l = 3\lambda/4$ , Eq. (9.56) becomes

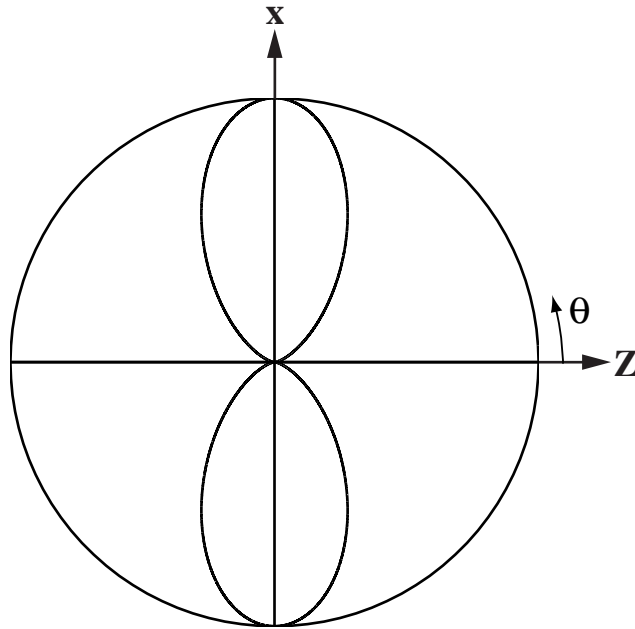
$$\begin{aligned} S(\theta) &= \frac{15I_0^2}{\pi R^2} \left[ \frac{\cos\left(\frac{3\pi}{4} \cos \theta\right) - \cos\left(\frac{3\pi}{4}\right)}{\sin \theta} \right]^2 \\ &= \frac{15I_0^2}{\pi R^2} \left[ \frac{\cos\left(\frac{3\pi}{4} \cos \theta\right) + \frac{1}{\sqrt{2}}}{\sin \theta} \right]^2. \end{aligned}$$

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  $S(\theta) = 15I_0^2/(\pi R^2)(2.91)$  at  $\theta_{\max}$ . Thus,

$$S_{\max} = \frac{15I_0^2}{\pi R^2} (2.91).$$



**Figure P9.16:** Radiation pattern of dipole of length  $l = 3\lambda/4$ .

(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),

$$F(\theta) = \frac{1}{2.91} \left[ \frac{\cos\left(\frac{3\pi}{4} \cos \theta\right) + \frac{1}{\sqrt{2}}}{\sin \theta} \right]^2.$$

The normalized radiation pattern is shown in Fig. P9.15.

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