

**9.47** An eight-element linear array with  $\lambda/2$  spacing is excited with equal amplitudes. To steer the main beam to a direction  $60^\circ$  below the broadside direction, what should be the incremental phase delay between adjacent elements? Also, give the expression for the array factor and plot the pattern.

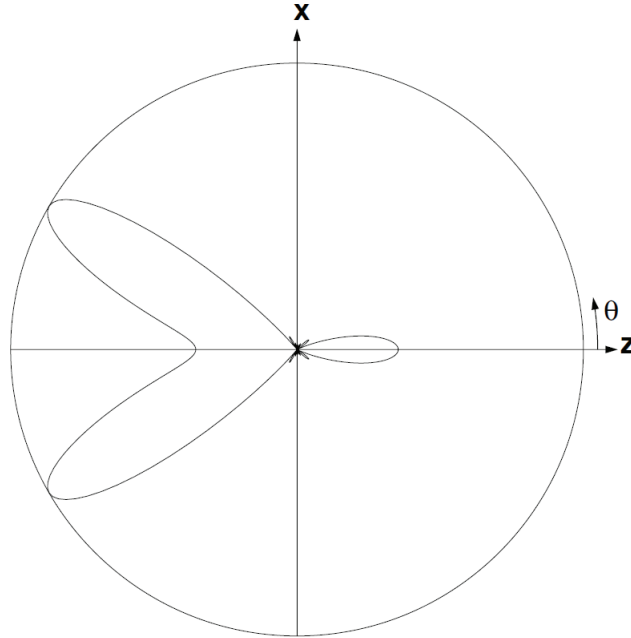
**Solution:** Since broadside corresponds to  $\theta = 90^\circ$ ,  $60^\circ$  below broadside is  $\theta_0 = 150^\circ$ . From Eq. (9.125),

$$\delta = kd \cos \theta_0 = \frac{2\pi \lambda}{\lambda} \frac{\lambda}{2} \cos 150^\circ = -2.72 \text{ (rad)} = -155.9^\circ.$$

Combining Eq. (9.126) with (9.127) gives

$$F_{\text{an}}(\theta) = \frac{\sin^2\left(\frac{1}{2}Nkd(\cos \theta - \cos \theta_0)\right)}{N^2 \sin^2\left(\frac{1}{2}kd(\cos \theta - \cos \theta_0)\right)} = \frac{\sin^2\left(4\pi\left(\cos \theta + \frac{1}{2}\sqrt{3}\right)\right)}{64 \sin^2\left(\frac{1}{2}\pi\left(\cos \theta + \frac{1}{2}\sqrt{3}\right)\right)}.$$

The pattern is shown in Fig. 9.47.



**Figure P9.47:** Pattern of the array of Problem 9.47.