9.38 If the antennas in part (a) of Problem 9.37 are parallel, vertical, Hertzian dipoles with axes along the x-direction, determine the normalized radiation intensity in the x–z plane and plot it.

Solution: The power density radiated by a Hertzian dipole is given from Eq. (9.12) by $S_e(\theta') = S_0 \sin^2\theta'$, where θ' is the angle measured from the dipole axis, which in the present case is the x axis (Fig. P9.38(a)).

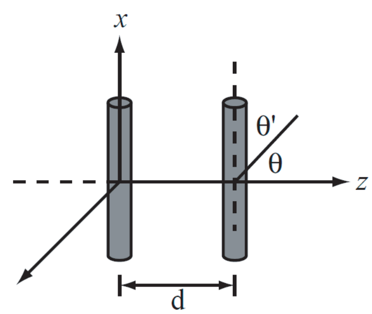

Figure P9.38 (a) Two vertical dipoles of Problem 9.38.

Hence, $\theta' = \pi/2 - \theta$ and $S_e(\theta) = S_0 \sin^2\left(\frac{1}{2}\pi - \theta\right) = S_0 \cos^2\theta$. Then, from Eq. (9.108), the total power density is the product of the element pattern and the array factor. From part (a) of the previous problem:

$$S(\theta) = S_e(\theta) F_a(\theta) = 4S_0 \cos^2\theta \cos^2\left[\frac{\pi}{8}(4\cos\theta + 1)\right].$$

This function has a maximum value of $3.52S_0$ and it occurs at $\theta_{max} = \pm 135.5°$. The maximum must be found by trial and error. A plot of the normalized array antenna pattern is shown in Fig. P9.38(b).

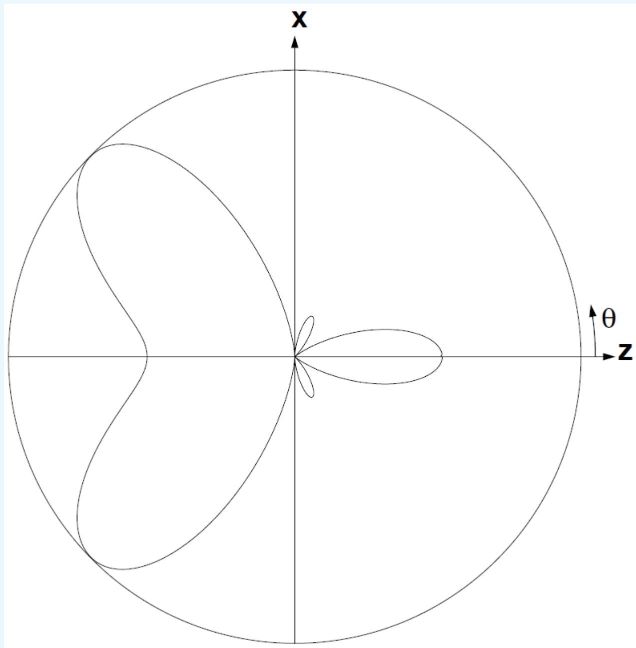

Figure P9.38 (b) Pattern factor in the elevation plane of the array in Problem 9.38(a).