4.7 For Problem 4.3, determine the polarization of the radiated far-zone fields (E_θ, E_ϕ) in the following planes:
(a) $\phi = 0°$ (b) $\phi = 90°$ (c) $\theta = 90°$

- Also, sketch polar plot of magnitude of electric field for each plane. Note: You do not need to make a comparison w/ problem 4.5.

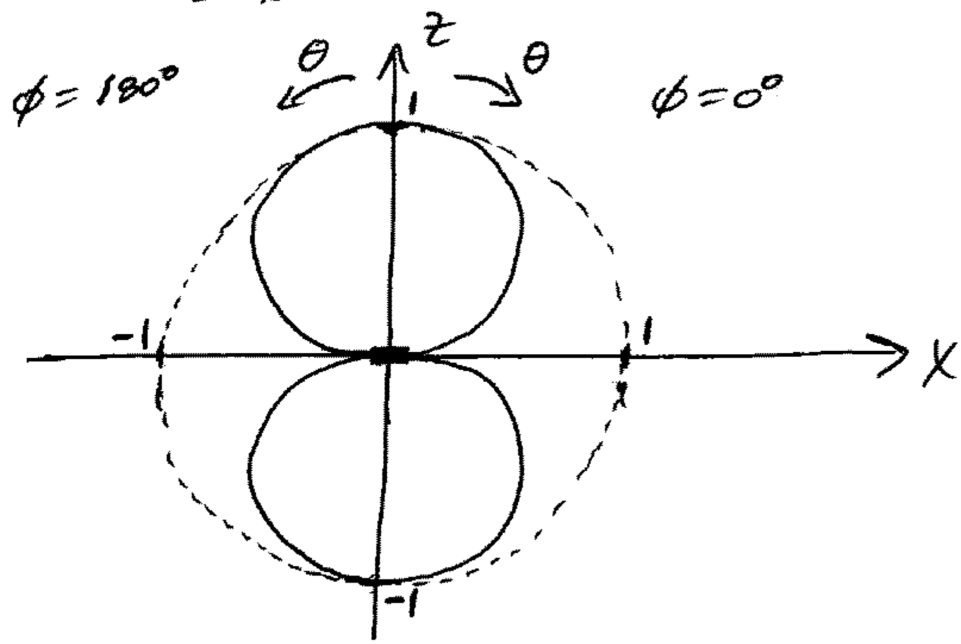
From 4.3 $\bar{E} = \frac{-j\omega\mu I_o \ell}{4\pi r} e^{-jkr}\left[\cos\theta\cos\phi\,\hat{a}_\theta - \sin\phi\,\hat{a}_\phi\right]$

a) $\phi = 0°$ (positive half of x-axis and z-plane)

$\bar{E}(\theta,\phi=0) = \frac{-j\omega\mu I_o \ell}{4\pi r} e^{-jkr}\left[\cos\theta\,\hat{a}_\theta\right]$

→ Single component means linear polarization

$$\frac{\bar{E}(\theta,\phi=0)}{\left[E(\theta,\phi=0)\right]_{max}} = \cos\theta$$

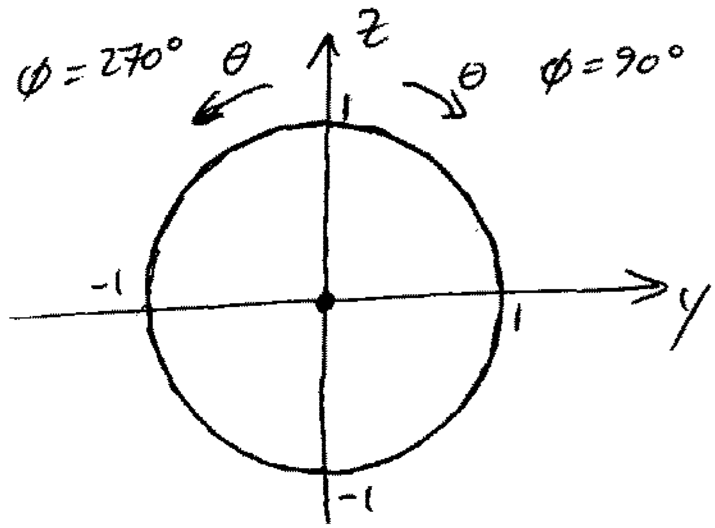


b) $\phi = 90°$ (positive half of y-axis & z-plane)

$$\bar{E}(\theta, \phi = 90°) = \frac{+j\omega\mu I_o l}{4\pi r} e^{-jkr} \hat{a}_\phi$$

→ Single component means linear polarization

$$\frac{\bar{E}(\theta, \phi = 90°)}{\left[\bar{E}(\theta, \phi = 90°)\right]_{max}} = 1$$



c) $\theta = 90°$ (x-y plane)

$$\bar{E}(\theta = 90°, \phi) = \frac{+j\omega\mu I_o l}{4\pi r} e^{-jkr} \sin\phi \, \hat{a}_\phi$$

→ Single component means linear polarization

$$\frac{\bar{E}(\theta = 90°, \phi)}{\left[\bar{E}(\theta = 90°, \phi)\right]_{max}} = \sin\phi$$