Problem 7.7 An RHC-polarized wave with a modulus of 2 (V/m) is traveling in free space in the negative z-direction. Write down the expression for the wave's electric field vector, given that the wavelength is 6 cm.

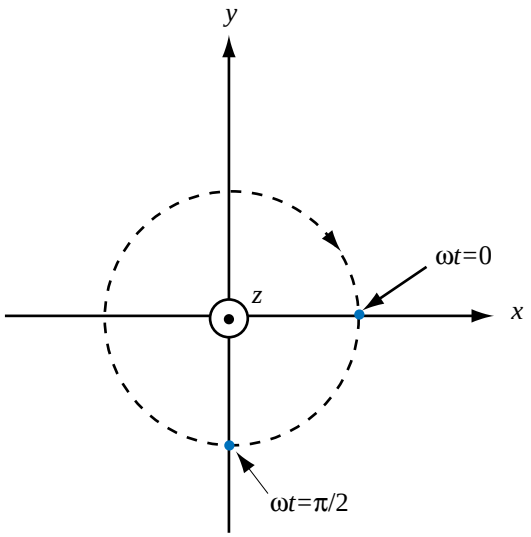

Figure P7.7: Locus of **E** versus time.

Solution: For an RHC wave traveling in $-\hat{\mathbf{z}}$, let us try the following:

$$\mathbf{E} = \hat{\mathbf{x}}\, a\cos(\omega t + kz) + \hat{\mathbf{y}}\, a\sin(\omega t + kz).$$

Modulus $|E| = \sqrt{a^2 + a^2} = a\sqrt{2} = 2$ (V/m). Hence,

$$a = \frac{2}{\sqrt{2}} = \sqrt{2}.$$

Next, we need to check the sign of the $\hat{\mathbf{y}}$-component relative to that of the $\hat{\mathbf{x}}$-component. We do this by examining the locus of **E** versus t at $z = 0$: Since the wave is traveling along $-\hat{\mathbf{z}}$, when the thumb of the right hand is along $-\hat{\mathbf{z}}$ (into the page), the other four fingers point in the direction shown (clockwise as seen from above). Hence, we should reverse the sign of the $\hat{\mathbf{y}}$-component:

$$\mathbf{E} = \hat{\mathbf{x}}\sqrt{2}\cos(\omega t + kz) - \hat{\mathbf{y}}\sqrt{2}\sin(\omega t + kz) \quad \text{(V/m)}$$

with

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{6 \times 10^{-2}} = 104.72 \quad \text{(rad/m)},$$

and

$$\omega = kc = \frac{2\pi}{\lambda} \times 3 \times 10^8 = \pi \times 10^{10} \quad \text{(rad/s)}.$$