

7.10 For a wave characterized by the electric field

$$\mathbf{E}(z, t) = \hat{\mathbf{x}}a_x \cos(\omega t - kz) + \hat{\mathbf{y}}a_y \cos(\omega t - kz + \delta)$$

identify the polarization state, determine the polarization angles (γ, χ) , and sketch the locus of $\mathbf{E}(0, t)$ for each of the following cases:

- (a) $a_x = 3$ V/m, $a_y = 4$ V/m, and $\delta = 0$
- (b) $a_x = 3$ V/m, $a_y = 4$ V/m, and $\delta = 180^\circ$
- (c) $a_x = 3$ V/m, $a_y = 3$ V/m, and $\delta = 45^\circ$
- (d) $a_x = 3$ V/m, $a_y = 4$ V/m, and $\delta = -135^\circ$

Solution:

$$\psi_0 = \tan^{-1}(a_y/a_x), \quad [\text{Eq. (7.60)}],$$

$$\tan 2\gamma = (\tan 2\psi_0) \cos \delta \quad [\text{Eq. (7.59a)}],$$

$$\sin 2\chi = (\sin 2\psi_0) \sin \delta \quad [\text{Eq. (7.59b)}].$$

Case	a_x	a_y	δ	ψ_0	γ	χ	Polarization State
(a)	3	4	0	53.13°	53.13°	0	Linear
(b)	3	4	180°	53.13°	-53.13°	0	Linear
(c)	3	3	45°	45°	45°	22.5°	Left elliptical
(d)	3	4	-135°	53.13°	-56.2°	-21.37°	Right elliptical

- (a) $\mathbf{E}(z, t) = \hat{\mathbf{x}}3 \cos(\omega t - kz) + \hat{\mathbf{y}}4 \cos(\omega t - kz).$
- (b) $\mathbf{E}(z, t) = \hat{\mathbf{x}}3 \cos(\omega t - kz) - \hat{\mathbf{y}}4 \cos(\omega t - kz).$
- (c) $\mathbf{E}(z, t) = \hat{\mathbf{x}}3 \cos(\omega t - kz) + \hat{\mathbf{y}}3 \cos(\omega t - kz + 45^\circ).$
- (d) $\mathbf{E}(z, t) = \hat{\mathbf{x}}3 \cos(\omega t - kz) + \hat{\mathbf{y}}4 \cos(\omega t - kz - 135^\circ).$

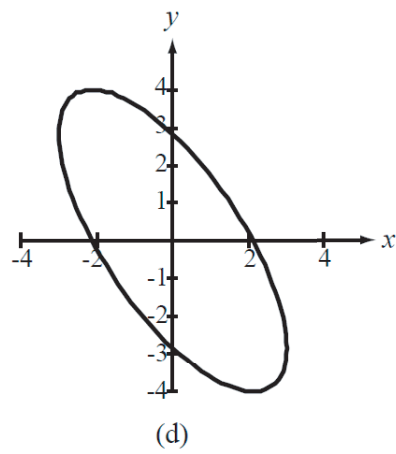
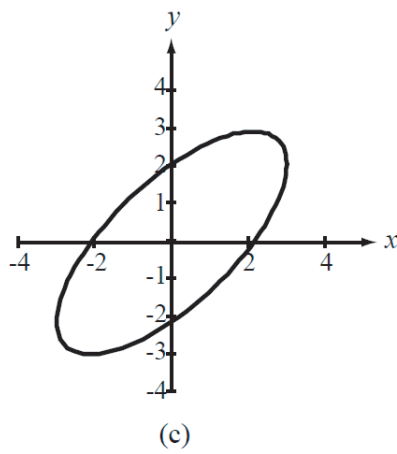
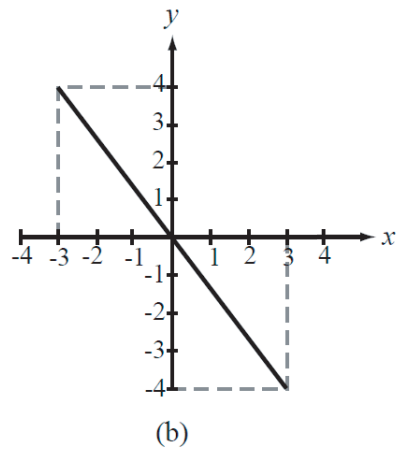
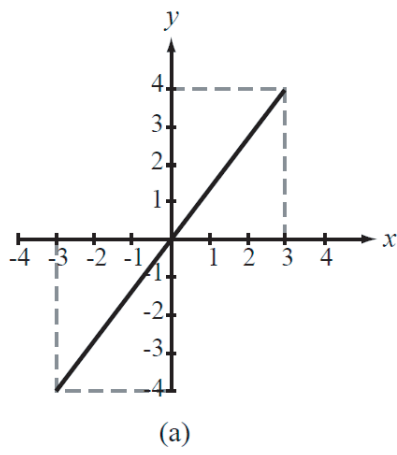


Figure P7.10 Plots of the locus of $\mathbf{E}(0, t)$.