

Problem 1.17 Complex numbers z_1 and z_2 are given by

$$\begin{aligned}z_1 &= 3 - j2 \\z_2 &= -4 + j3\end{aligned}$$

- (a) Express z_1 and z_2 in polar form.
- (b) Find $|z_1|$ by first applying Eq. (1.41) and then by applying Eq. (1.43).
- (c) Determine the product $z_1 z_2$ in polar form.
- (d) Determine the ratio z_1/z_2 in polar form.
- (e) Determine z_1^3 in polar form.

Solution:

- (a) Using Eq. (1.41),

$$\begin{aligned}z_1 &= 3 - j2 = 3.6e^{-j33.7^\circ}, \\z_2 &= -4 + j3 = 5e^{j143.1^\circ}.\end{aligned}$$

- (b) By Eq. (1.41) and Eq. (1.43), respectively,

$$\begin{aligned}|z_1| &= |3 - j2| = \sqrt{3^2 + (-2)^2} = \sqrt{13} = 3.60, \\|z_1| &= \sqrt{(3 - j2)(3 + j2)} = \sqrt{13} = 3.60.\end{aligned}$$

- (c) By applying Eq. (1.47b) to the results of part (a),

$$z_1 z_2 = 3.6e^{-j33.7^\circ} \times 5e^{j143.1^\circ} = 18e^{j109.4^\circ}.$$

- (d) By applying Eq. (1.48b) to the results of part (a),

$$\frac{z_1}{z_2} = \frac{3.6e^{-j33.7^\circ}}{5e^{j143.1^\circ}} = 0.72e^{-j176.8^\circ}.$$

- (e) By applying Eq. (1.49) to the results of part (a),

$$z_1^3 = (3.6e^{-j33.7^\circ})^3 = (3.6)^3 e^{-j3 \times 33.7^\circ} = 46.66e^{-j101.1^\circ}.$$
