

**1.22** Complex numbers  $z_1$  and  $z_2$  are given by

$$z_1 = 5 \angle -60^\circ$$

$$z_2 = 4 \angle 45^\circ.$$

- (a) Determine the product  $z_1 z_2$  in polar form.
- (b) Determine the product  $z_1 z_2^*$  in polar form.
- (c) Determine the ratio  $z_1 / z_2$  in polar form.
- (d) Determine the ratio  $z_1^* / z_2^*$  in polar form.
- (e) Determine  $\sqrt{z_1}$  in polar form.

**Solution:**

(a)  $z_1 z_2 = 5e^{-j60^\circ} \times 4e^{j45^\circ} = 20e^{-j15^\circ}.$

(b)  $z_1 z_2^* = 5e^{-j60^\circ} \times 4e^{-j45^\circ} = 20e^{-j105^\circ}.$

(c)  $\frac{z_1}{z_2} = \frac{5e^{-j60^\circ}}{4e^{j45^\circ}} = 1.25e^{-j105^\circ}.$

(d)  $\frac{z_1^*}{z_2^*} = \left( \frac{z_1}{z_2} \right)^* = 1.25e^{j105^\circ}.$

(e)  $\sqrt{z_1} = \sqrt{5e^{-j60^\circ}} = \pm \sqrt{5}e^{-j30^\circ}.$

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