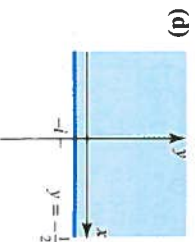


(c) $2i$



(d) $y = -2$

23. (a) $\frac{x_1 x_2 + y_1 y_2}{x_2^2 + y_2^2}$ (b) $\frac{x_2 y_1 - x_1 y_2}{x_2^2 + y_2^2}$ 27. (c) Yes, if $z \neq 0$.

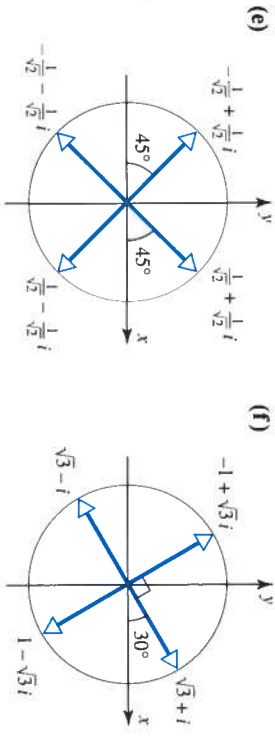
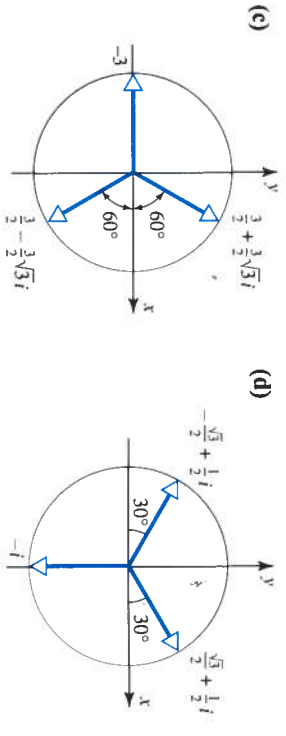
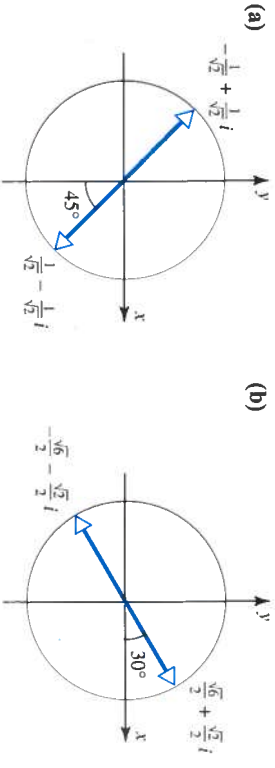
30. $x_1 = \frac{1}{2} + i, x_2 = 2, x_3 = \frac{1}{2} - i$ 33. $x_1 = (1+i)i, x_2 = 2i$

35. (a) $\begin{bmatrix} i & 2 \\ -1 & i \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 1 \\ -i & 2i \end{bmatrix}$

39. (a) $\begin{bmatrix} -i & -2-2i & -1+i \\ 1 & 2 & -i \\ i & i & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1+i & -i & 1 \\ -7+6i & 5-i & 1+4i \\ 1+2i & -i & 1 \end{bmatrix}$

Exercise Set 10.3
(page 539)

1. (a) 0 (b) $\pi/2$ (c) $-\pi/2$ (d) $\pi/4$ (e) $2\pi/3$ (f) $-\pi/4$
3. (a) $2 \left[\cos\left(\frac{\pi}{2}\right) + i \sin\left(\frac{\pi}{2}\right) \right]$ (b) $4[\cos \pi + i \sin \pi]$
- (c) $5\sqrt{2} \left[\cos\left(\frac{\pi}{4}\right) + i \sin\left(\frac{\pi}{4}\right) \right]$ (d) $12 \left[\cos\left(\frac{2\pi}{3}\right) + i \sin\left(\frac{2\pi}{3}\right) \right]$
- (e) $3\sqrt{2} \left[\cos\left(-\frac{3\pi}{4}\right) + i \sin\left(-\frac{3\pi}{4}\right) \right]$ (f) $4 \left[\cos\left(-\frac{\pi}{6}\right) + i \sin\left(-\frac{\pi}{6}\right) \right]$



Exercise Set 10.4
(page 544)

10. $\sqrt{2} \left[\cos\left(\frac{\pi}{8}\right) + i \sin\left(\frac{\pi}{8}\right) \right], \sqrt{2} \left[\cos\left(\frac{\pi}{8}\right) + i \sin\left(\frac{\pi}{8}\right) \right]$
12. The roots are $\pm(2^{1/4} + 2^{1/4}i), \pm(2^{1/4} - 2^{1/4}i)$ and the factorization is $z^4 + 8 = (z^2 - 2^{5/4}z + 2^{3/2})(z^2 + 2^{5/4}z + 2^{3/2})$.
15. (a) $\text{Re}(z) = -3, \text{Im}(z) = 0$ (b) $\text{Re}(z) = -3, \text{Im}(z) = 0$
- (c) $\text{Re}(z) = 0, \text{Im}(z) = -\sqrt{2}$ (d) $\text{Re}(z) = -3, \text{Im}(z) = 0$
20. $\cos 2\theta = \cos^2 \theta - \sin^2 \theta, \sin 2\theta = 2 \sin \theta \cos \theta$
- $\cos 3\theta = \cos^3 \theta - 3 \sin^2 \theta \cos \theta, \sin 3\theta = 3 \sin \theta \cos^2 \theta - \sin^3 \theta$
1. (a) $(3i, -i, -2-i, 4)$ (b) $(3+2i, -1-2i, -3+5i, -i)$
- (c) $(-1-2i, 2i, 2-i, -1)$ (d) $(-3+9i, 3-3i, -3-6i, 12+3i)$
- (e) $(-3+2i, 3, -3-3i, i)$ (f) $(-1-5i, 3i, 4, -5)$
5. (a) $\sqrt{2}$ (b) $2\sqrt{3}$ (c) $\sqrt{10}$ (d) $\sqrt{37}$
9. (a) 3 (b) $2-27i$ (c) $-5-10i$
11. Not a vector space. Axiom 6 fails; that is, the set is not closed under scalar multiplication. (Multiply by i , for example.)
13. $\ker T$ is all multiples of $\begin{bmatrix} 1+3i \\ 1+i \\ -2 \end{bmatrix}$; nullity of $T = 1$
17. (a) $(-3-2i)u + (3-i)v + (1+2i)w$ (b) $(2+i)u + (-1+i)v + (-1-i)w$
- (c) $0u + 0v + 0w$ (d) $(-5-4i)u + (5+2i)v + (2+4i)w$
19. (a), (b), (c) 21. (b), (c) 23. $f - 3g - 3h = 0$ 25. (a), (b)
27. $(-1-i, 1)$; dimension = 1 30. $(\frac{3}{2}i, -\frac{1}{2}, 1, 0), (-\frac{1}{4}, \frac{3}{4}i, 0, 1)$; dimension = 2

Exercise Set 10.5
(page 551)

2. (a) -12 (b) 0 (c) $2i$ (d) 37
4. (a) $-4+5i$ (b) 0 (c) $4-4i$ (d) 42 6. $-9-5i$
8. No. Axiom 4 fails. 10. (a) $\sqrt{10}$ (b) 2 (c) $\sqrt{5}$ (d) 0
12. (a) $3\sqrt{10}$ (b) $\sqrt{14}$ 14. (a) 2 (b) $2\sqrt{2}$
16. (a) $7\sqrt{2}$ (b) $2\sqrt{3}$ 20. (b)
23. $\left(\frac{i}{\sqrt{2}}, 0, \frac{i}{\sqrt{2}}\right), \left(-\frac{i}{\sqrt{6}}, 0, \frac{2i}{\sqrt{6}}, \frac{i}{\sqrt{6}}\right), \left(\frac{2i}{\sqrt{21}}, \frac{3i}{\sqrt{21}}, \frac{2i}{\sqrt{21}}, \frac{-2i}{\sqrt{21}}\right), \left(-\frac{i}{\sqrt{7}}, \frac{2i}{\sqrt{7}}, -\frac{i}{\sqrt{7}}, \frac{i}{\sqrt{7}}\right)$
25. (a) $v_1 = \left(\frac{i}{\sqrt{3}}, \frac{i}{\sqrt{3}}, \frac{i}{\sqrt{3}}\right), v_2 = \left(-\frac{i}{\sqrt{2}}, \frac{i}{\sqrt{2}}, 0\right), v_3 = \left(\frac{i}{\sqrt{6}}, \frac{i}{\sqrt{6}}, -\frac{2i}{\sqrt{6}}\right)$
- (b) $v_1 = (i, 0, 0), v_2 = \left(0, \frac{7i}{\sqrt{53}}, \frac{-2i}{\sqrt{53}}\right), v_3 = \left(0, \frac{2i}{\sqrt{53}}, \frac{7i}{\sqrt{53}}\right)$
27. $v_1 = \left(0, \frac{i}{\sqrt{3}}, \frac{1-i}{\sqrt{3}}\right), v_2 = \left(-\frac{3i}{\sqrt{15}}, \frac{2}{\sqrt{15}}, \frac{1+i}{\sqrt{15}}\right)$
36. $u = -\sqrt{3}iv_1 + \frac{3}{\sqrt{6}}v_2 - \frac{1}{\sqrt{2}}v_3$

Exercise Set 10.6
(page 561)

1. (a) $\begin{bmatrix} -2i & 4 & 5-i \\ 1+i & 3-i & 0 \end{bmatrix}$ (b) $\begin{bmatrix} -2i & 4 & -i \\ 1+i & 5+7i & 3 \\ -1-i & i & 1 \end{bmatrix}$
- (c) $\begin{bmatrix} -7i \\ 0 \\ 3i \end{bmatrix}$ (d) $\begin{bmatrix} \bar{a}_{11} & \bar{a}_{21} \\ \bar{a}_{12} & \bar{a}_{22} \\ \bar{a}_{13} & \bar{a}_{23} \end{bmatrix}$
3. $k = 3+5i, l = i, m = 2-4i$ 4. (a), (b)