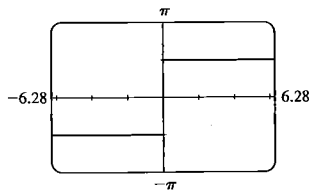


50. (a)



Conjecture: $y = \begin{cases} \pi/2, & x > 0 \\ -\pi/2, & x < 0 \end{cases}$

51. (a) 0.28 (b) $(-3 + \sqrt{17})/4$

52. (a) 0.71 (b) $\sqrt{2}/2$

53. (a) $h = 2 \tan \theta$ (b) $\theta = \tan^{-1}(h/2)$

54. (a) $\theta = \tan^{-1}\left(\frac{50}{s}\right)$ (b) $\theta \approx 68.2^\circ$

55. (a) $\theta = \sin^{-1}(h/680)$ (b) $\theta = 0.826 \text{ rad}$

56. (a) $\theta = \cos^{-1}\left(\frac{3960}{h + 3960}\right)$ (b) $s = 7920 \theta$

(c) $s = 7920 \cos^{-1}\left(\frac{3960}{h + 3960}\right)$ (d) 1761.5 mi

(e) 197.3 mi

57. (a) 54.1° (b) $48.3^\circ, 32.2^\circ, 24.5^\circ$. The function \sin^{-1} is undefined for values outside the interval $[-1, 1]$.

Section 7.5 ■ page 568

1. $(2k + 1)\pi$ 2. $\frac{3\pi}{2} + 2k\pi$ 3. $\frac{\pi}{6} + 2k\pi, \frac{5\pi}{6} + 2k\pi$

4. $\frac{\pi}{4} + 2k\pi, \frac{7\pi}{4} + 2k\pi$ 5. $\frac{5\pi}{6} + k\pi$ 6. $\frac{3\pi}{4} + k\pi$

7. $\frac{\pi}{3} + k\pi, \frac{2\pi}{3} + k\pi$ 8. $\frac{\pi}{4} + k\pi, \frac{3\pi}{4} + k\pi$ 9. $\frac{(2k + 1)\pi}{4}$

10. $\frac{\pi}{6} + k\pi, \frac{5\pi}{6} + k\pi$ 11. $\frac{\pi}{3} + k\pi, \frac{2\pi}{3} + k\pi$

12. $\frac{\pi}{4} + k\pi, \frac{3\pi}{4} + k\pi$ 13. $\frac{\pi}{2} + k\pi, \frac{7\pi}{6} + 2k\pi, \frac{11\pi}{6} + 2k\pi$

14. $\frac{\pi}{4} + 2k\pi, \frac{7\pi}{4} + 2k\pi$ 15. $-\frac{\pi}{3} + k\pi$

16. $\frac{\pi}{6} + k\pi, \frac{5\pi}{6} + 2k\pi$ 17. $\frac{\pi}{2} + k\pi$ 18. $k\pi, \frac{3\pi}{4} + k\pi$

19. $\frac{\pi}{3} + 2k\pi, \frac{5\pi}{3} + 2k\pi$

20. $\frac{\pi}{2} + 2k\pi, \frac{7\pi}{6} + 2k\pi, \frac{11\pi}{6} + 2k\pi$ 21. $\frac{3\pi}{2} + 2k\pi$

22. $k\pi, \frac{\pi}{6} + k\pi, \frac{5\pi}{6} + k\pi$ 23. No solution

24. $\frac{\pi}{2} + 2k\pi, \frac{7\pi}{6} + 2k\pi, \frac{11\pi}{6} + 2k\pi$

25. $\frac{7\pi}{18} + \frac{2k\pi}{3}, \frac{11\pi}{18} + \frac{2k\pi}{3}$ 26. $\frac{\pi}{3} + k\pi, \frac{2\pi}{3} + k\pi$

27. $\frac{1}{4}\left(\frac{\pi}{3} + 2k\pi\right), \frac{1}{4}\left(-\frac{\pi}{3} + 2k\pi\right)$ 28. $\frac{5\pi}{18} + \frac{1}{3}k\pi$

29. $\frac{1}{2}\left(\frac{\pi}{6} + k\pi\right)$ 30. $\frac{\pi}{6} + \frac{k\pi}{3}$ 31. $4k\pi$

32. $4\pi + 6k\pi, 5\pi + 6k\pi$ 33. $4\left(\frac{2\pi}{3} + k\pi\right)$

34. $2k\pi$ 35. $\frac{k\pi}{3}$

36. $\frac{\pi}{4} + k\pi, \frac{\pi}{6} + k\pi, \frac{5\pi}{6} + k\pi$

37. $\frac{\pi}{6} + 2k\pi, \frac{2\pi}{3} + 2k\pi, \frac{5\pi}{6} + 2k\pi, \frac{4\pi}{3} + 2k\pi$

38. $\frac{k\pi}{2}$ 39. $\frac{\pi}{8} + \frac{k\pi}{2}, \frac{3\pi}{8} + \frac{k\pi}{2}$ 40. $k\pi$

41. $\frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}, \frac{11\pi}{9}, \frac{13\pi}{9}, \frac{17\pi}{9}$ 42. $\frac{\pi}{3}, \frac{2\pi}{3}$

43. $\frac{\pi}{6}, \frac{3\pi}{4}, \frac{5\pi}{6}, \frac{7\pi}{4}$ 44. $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

45. $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$ 46. $\frac{\pi}{3}, \frac{5\pi}{3}, \pi$

47. $0, \frac{2\pi}{3}, \frac{4\pi}{3}$ 48. $0, \frac{\pi}{6}, \frac{5\pi}{6}, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}$

49. (a) $1.15928 + 2k\pi, 5.12391 + 2k\pi$
(b) 1.15928, 5.12391

50. (a) $1.41815 + k\pi$ (b) 1.41815, 4.55974

51. (a) $1.36944 + 2k\pi, 4.91375 + 2k\pi$
(b) 1.36944, 4.91375

52. (a) $1.16590 + k\pi$ (b) 1.16590, 4.30750

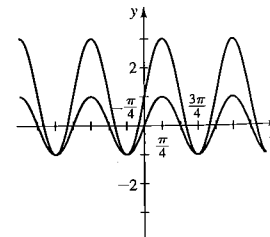
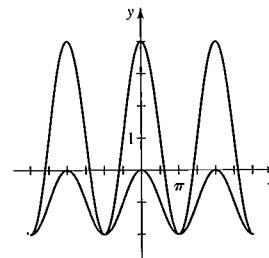
53. (a) $0.46365 + k\pi, 2.67795 + k\pi$
(b) 0.46365, 2.67795, 3.60524, 5.81954

54. (a) $0.25268 + 2k\pi, 1.57080 + k\pi, 2.88891 + 2k\pi$
(b) 0.25268, 1.57080, 2.88891, 4.71239

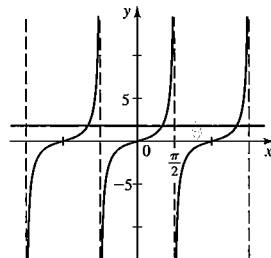
55. (a) $0.33984 + 2k\pi, 2.80176 + 2k\pi$
(b) 0.33984, 2.80176

56. (a) $1.10715 + k\pi, 1.24905 + k\pi, 1.89255 + k\pi, 2.03444 + k\pi$
(b) 1.10715, 1.24905, 1.89255, 2.03444, 4.24874, 4.39064, 5.03414, 5.17604

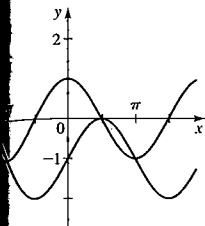
57. $((2k + 1)\pi, -2)$ 58. $\left(\frac{3\pi}{4} + k\pi, -1\right)$



$$\left(\frac{\pi}{3} + k\pi, \sqrt{3}\right)$$



$$+ 2k\pi, -1), \left(\frac{\pi}{2} + 2k\pi, 0\right)$$



$$\frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8}, \frac{15\pi}{8} \quad 62. \frac{\pi}{3}, \frac{5\pi}{3}$$

$$\frac{2\pi}{9}, \frac{7\pi}{9}, \frac{8\pi}{9}, \frac{13\pi}{9}, \frac{14\pi}{9} \quad 64. 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}$$

$$\frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6} \quad 66. 0, \frac{\pi}{2}, \frac{3\pi}{2} \quad 67. 0$$

$$\frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8}, \frac{15\pi}{8} \quad 69. \frac{k\pi}{2} \quad 70. \frac{k\pi}{6}$$

$$+ \frac{2k\pi}{3}, \frac{\pi}{2} + k\pi, \frac{5\pi}{9} + \frac{2k\pi}{3} \quad 72. \frac{(2k+1)\pi}{8}$$

$$\pm 0.95 \quad 74. -2.94, -2.66, 1.17 \quad 75. 1.92$$

$$\pm 0.93 \quad 77. \pm 0.71 \quad 78. 0$$

$$94721^\circ \text{ or } 89.05279^\circ \quad 80. 0, \frac{1}{2}, 1, \frac{3}{2}, \dots$$

$$9.95^\circ \quad 82. \theta_1 = \sin^{-1}(v_1/v_2)$$

$$(a) 34\text{th day (February 3rd), 308\text{th day (November 4th)}$$

75 days

$$(a) 0^\circ \quad (b) 60^\circ, 120^\circ \quad (c) 90^\circ, 270^\circ \quad (d) 180^\circ$$

$$(e) 1.047 \approx 60^\circ$$

Chapter 7 Review ■ page 571

$$\begin{aligned} \text{LHS} &= \sin \theta \left(\frac{\cos \theta}{\sin \theta} + \frac{\sin \theta}{\cos \theta} \right) = \cos \theta + \frac{\sin^2 \theta}{\cos \theta} \\ &= \frac{\cos^2 \theta + \sin^2 \theta}{\cos \theta} = \text{RHS} \end{aligned}$$

$$\text{LHS} = \sec^2 \theta - 1 = \text{RHS}$$

$$\begin{aligned} \text{LHS} &= (1 - \sin^2 x) \csc x - \csc x \\ &= \csc x - \sin^2 x \csc x - \csc x \\ &= -\sin^2 x \frac{1}{\sin x} = \text{RHS} \end{aligned}$$

$$4. \text{LHS} = \frac{1}{\cos^2 x} = \sec^2 x = \text{RHS}$$

$$5. \text{LHS} = \frac{\cos^2 x}{\sin^2 x} - \frac{\tan^2 x}{\sin^2 x} = \cot^2 x - \frac{1}{\cos^2 x} = \text{RHS}$$

$$\begin{aligned} 6. \text{LHS} &= \frac{1}{\sec x} + 1 = 1 + \cos x = (1 + \cos x) \cdot \frac{1 - \cos x}{1 - \cos x} \\ &= \frac{1 - \cos^2 x}{1 - \cos x} = \text{RHS} \end{aligned}$$

$$7. \text{LHS} = \frac{\cos x}{\frac{1}{\cos x}(1 - \sin x)} = \frac{\cos x}{\frac{1}{\cos x} - \frac{\sin x}{\cos x}} = \text{RHS}$$

$$\begin{aligned} 8. \text{LHS} &= 1 - \cot x - \tan x + \tan x \cot x \\ &= 2 - (\cot x + \tan x) \\ &= 2 - \left(\frac{\cos x}{\sin x} + \frac{\sin x}{\cos x} \right) = 2 - \frac{\cos^2 x + \sin^2 x}{\cos x \sin x} \\ &= 2 - \frac{1}{\cos x \sin x} = \text{RHS} \end{aligned}$$

$$9. \text{LHS} = \sin^2 x \frac{\cos^2 x}{\sin^2 x} + \cos^2 x \frac{\sin^2 x}{\cos^2 x} = \cos^2 x + \sin^2 x = \text{RHS}$$

$$\begin{aligned} 10. \text{LHS} &= \left(\frac{\sin x}{\cos x} + \frac{\cos x}{\sin x} \right)^2 = \left(\frac{\sin^2 x + \cos^2 x}{\cos x \sin x} \right)^2 \\ &= \left(\frac{1}{\cos x \sin x} \right)^2 = \text{RHS} \end{aligned}$$

$$11. \text{LHS} = \frac{2 \sin x \cos x}{1 + 2 \cos^2 x - 1} = \frac{2 \sin x \cos x}{2 \cos^2 x} = \frac{2 \sin x}{2 \cos x} = \text{RHS}$$

$$\begin{aligned} 12. \text{LHS} &= \frac{\cos x \cos y - \sin x \sin y}{\cos x \sin y} \\ &= \frac{\cos x \cos y}{\cos x \sin y} - \frac{\sin x \sin y}{\cos x \sin y} = \frac{\cos y}{\sin y} - \frac{\sin x}{\cos x} = \text{RHS} \end{aligned}$$

$$13. \text{LHS} = \frac{1 - \cos x}{\sin x} = \frac{1}{\sin x} - \frac{\cos x}{\sin x} = \text{RHS}$$

$$\begin{aligned} 14. \text{LHS} &= \frac{2 \sin \left(\frac{(x+y) + (x-y)}{2} \right) \cos \left(\frac{(x+y) - (x-y)}{2} \right)}{2 \cos \left(\frac{(x+y) + (x-y)}{2} \right) \cos \left(\frac{(x+y) - (x-y)}{2} \right)} \\ &= \frac{2 \sin x \cos y}{2 \cos x \cos y} = \text{RHS} \end{aligned}$$

$$\begin{aligned} 15. \text{LHS} &= \frac{1}{2} [\cos((x+y) - (x-y)) \\ &\quad - \cos((x+y) + (x-y))] \\ &= \frac{1}{2} (\cos 2y - \cos 2x) \\ &= \frac{1}{2} [1 - 2 \sin^2 y - (1 - 2 \sin^2 x)] \\ &= \frac{1}{2} (2 \sin^2 x - 2 \sin^2 y) = \text{RHS} \end{aligned}$$

$$\begin{aligned} 16. \text{LHS} &= \csc x - \frac{1 - \cos x}{\sin x} \\ &= \csc x - (\csc x - \cot x) = \text{RHS} \end{aligned}$$

$$\begin{aligned} 17. \text{LHS} &= 1 + \frac{\sin x}{\cos x} \cdot \frac{1 - \cos x}{\sin x} = 1 + \frac{1 - \cos x}{\cos x} \\ &= 1 + \frac{1}{\cos x} - 1 = \text{RHS} \end{aligned}$$

$\sqrt{1+x^2}$ 74. $\frac{1}{\sqrt{1-x^2}}$ 75. $\theta = \cos^{-1}\left(\frac{x}{3}\right)$
 $= \tan^{-1}\left(\frac{x}{2}\right)$
 $\theta = \tan^{-1}\left(\frac{10}{x}\right)$ (b) 286.4 ft
 $\theta = \tan^{-1}\left(\frac{420}{x}\right) - \tan^{-1}\left(\frac{380}{x}\right)$ (b) 400 ft

er 7 Test ■ page 574

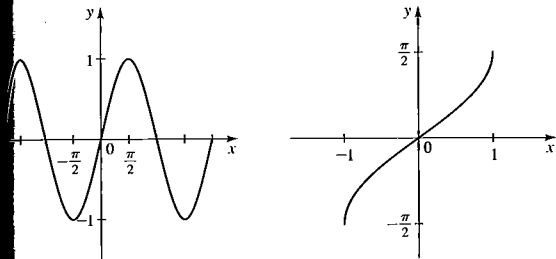
$$\text{LHS} = \frac{\sin \theta}{\cos \theta} \sin \theta + \cos \theta = \frac{\sin^2 \theta + \cos^2 \theta}{\cos \theta} = \text{RHS}$$

$$\text{S} = \frac{\tan x}{1 - \cos x} \cdot \frac{1 + \cos x}{1 + \cos x} = \frac{\tan x(1 + \cos x)}{1 - \cos^2 x}$$

$$= \frac{\frac{\sin x}{\cos x}(1 + \cos x)}{\sin^2 x} = \frac{1}{\sin x} \cdot \frac{1 + \cos x}{\cos x} = \text{RHS}$$

$$\text{S} = \frac{2 \tan x}{\sec^2 x} = \frac{2 \sin x}{\cos x} \cdot \cos^2 x = 2 \sin x \cos x = \text{RHS}$$

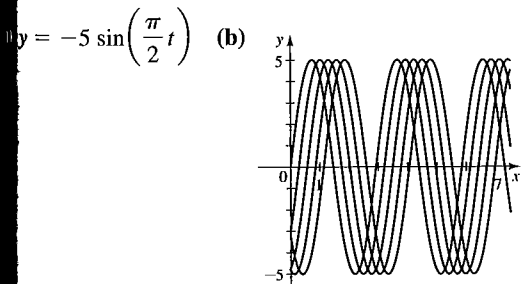
(b) $\frac{\sqrt{2} + \sqrt{6}}{4}$ (c) $\frac{1}{2}\sqrt{2 - \sqrt{3}}$
 $-2\sqrt{5}/15$
 $\frac{1}{2}(\sin 8x - \sin 2x)$ (b) $-2 \cos \frac{7}{2}x \sin \frac{3}{2}x$ 6. -2



Domain \mathbb{R} Domain $[-1, 1]$
 $\theta = \tan^{-1}\frac{x}{4}$ (b) $\theta = \cos^{-1}\frac{3}{x}$

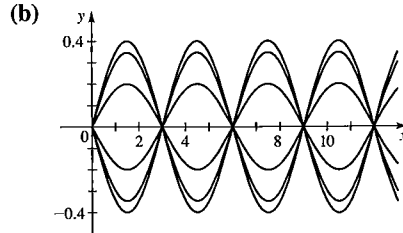
$\frac{2\pi}{3}, \frac{4\pi}{3}$ (b) $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$
 7964, 2.56195, 3.72123, 5.70355 11. $\frac{40}{41}$

son Modeling ■ page 578



$\pi/4$ Yes, it is a traveling wave.

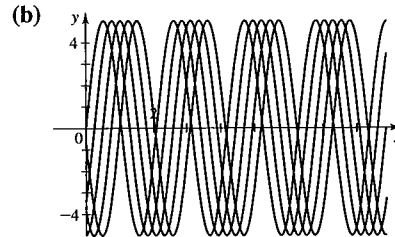
2. (a) $y = 0.4 \sin(1.047x) \cos(0.524t)$; 3, 6, 9, 12, ...



Yes, this is a standing wave.

3. $y(x, t) = 2.7 \sin(0.68x - 4.10t)$

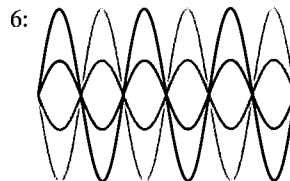
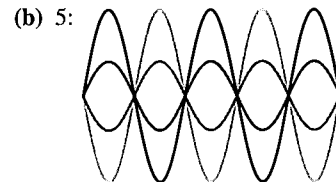
4. (a) $y(x, t) = 5 \sin(3x - 1.5t)$



5. $y(x, t) = 0.6 \sin(\pi x) \cos(40\pi t)$

6. $y(x, t) = 7 \sin 2x \cos \frac{1}{2}t$

7. (a) 1, 2, 3, 4



(c) 880π

(d) $y(x, t) = \sin t \cos(880\pi t)$;

$y(x, t) = \sin(2t) \cos(880\pi t)$;

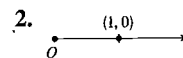
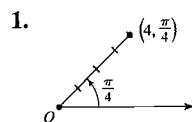
$y(x, t) = \sin(3t) \cos(880\pi t)$;

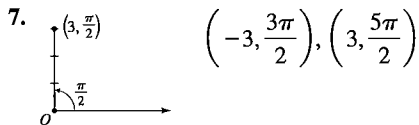
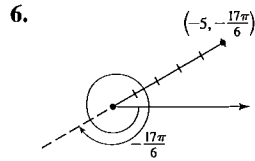
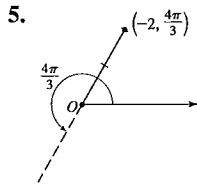
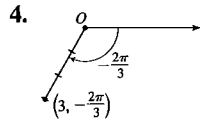
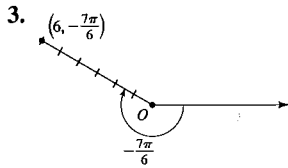
$y(x, t) = \sin(4t) \cos(880\pi t)$

8. (a) $\pi, 3\pi, 5\pi, 7\pi, 9\pi, 11\pi$; no (b) 25 Hz

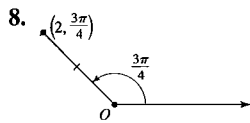
Chapter 8

Section 8.1 ■ page 586

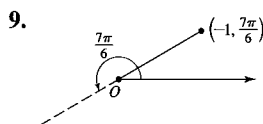




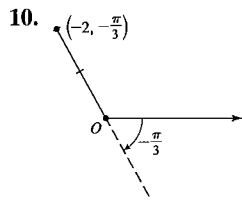
$(-3, \frac{3\pi}{2}), (3, \frac{5\pi}{2})$



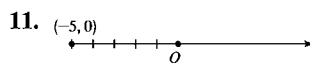
$(-2, \frac{7\pi}{4}), (2, \frac{11\pi}{4})$



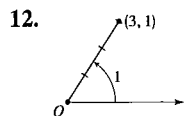
$(-1, -\frac{5\pi}{6}), (1, \frac{\pi}{6})$



$(-2, \frac{5\pi}{3}), (2, \frac{2\pi}{3})$



$(-5, 2\pi), (5, \pi)$



$(3, 1 + 2\pi), (-3, 1 + \pi)$

13. Q 14. R 15. Q 16. P 17. P 18. Q 19. P

20. S 21. $(3\sqrt{2}, 3\pi/4)$ 22. $(3, 3\pi/2)$

23. $(-\frac{5}{2}, -\frac{5\sqrt{3}}{2})$ 24. $(-\frac{3\sqrt{3}}{2}, 1)$ 25. $(2\sqrt{3}, 2)$

26. $(-3, 3\sqrt{3})$ 27. $(1, -1)$ 28. $(0, -1)$ 29. $(-5, 0)$

30. $(0, 0)$ 31. $(3\sqrt{6}, -3\sqrt{2})$ 32. $(\sqrt{3}/2, \frac{3}{2})$

33. $(\sqrt{2}, 3\pi/4)$ 34. $(6, 11\pi/6)$ 35. $(4, \pi/4)$

36. $(2\sqrt{2}, 7\pi/6)$ 37. $(5, \tan^{-1} \frac{4}{3})$

38. $(\sqrt{5}, 2\pi + \tan^{-1}(-2))$ 39. $(6, \pi)$ 40. $(\sqrt{3}, 3\pi/2)$

41. $\theta = \pi/4$ 42. $r = 3$ 43. $r = \tan \theta \sec \theta$

44. $r = 5 \csc \theta$ 45. $r = 4 \sec \theta$ 46. $r^2 = \sec 2\theta$

47. $x^2 + y^2 = 49$ 48. $y = 0$ 49. $x = 6$

50. $(x - 3)^2 + y^2 = 9$ 51. $x^2 + y^2 = \frac{y}{x}$

52. $x^4 + 2x^2y^2 + y^4 - 2xy = 0$ 53. $y - x = 1$
 54. $x^2 + 2y - 1 = 0$ 55. $x^2 + y^2 = (x^2 + y^2 - x)^2$
 56. $x^2 - 3y^2 + 16y - 16 = 0$ 57. $x = 2$
 58. $(x^2 + y^2 - x)^2 = 4(x^2 + y^2)$ 59. $y = \pm \sqrt{3}x$
 60. $y = 0$

Section 8.2 ■ page 594

1. VI 2. III 3. II 4. IV 5. I 6. V

7. Symmetric about $\theta = \pi/2$

8. Symmetric about the polar axis

9. Symmetric about the polar axis

10. Symmetric about the pole

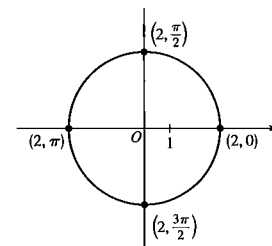
11. Symmetric about $\theta = \pi/2$

12. Symmetric about the polar axis

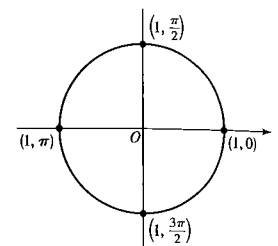
13. All three types of symmetry

14. Symmetric about the pole and about $\theta = \pi/2$

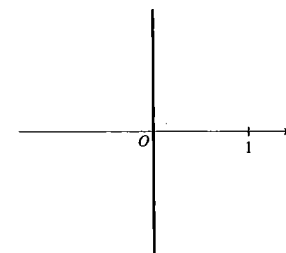
15.



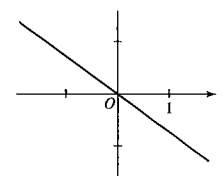
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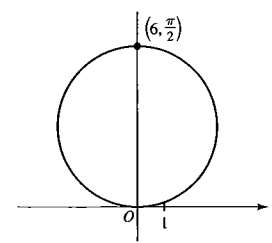
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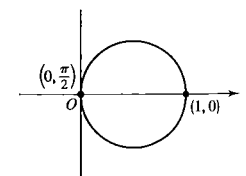
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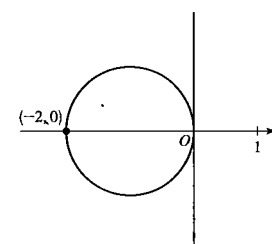
19.



20.



21.



22.

