33. $\sum_{k=1}^{\infty} k(10x)^{k-1}; \left(-\frac{1}{10}, \frac{1}{10}\right)$ **35.** $1 + 3x + \frac{9x^2}{2!}; \sum_{k=0}^{\infty} \frac{(3x)^k}{k!}$

37. $-(x - \pi/2) + \frac{(x - \pi/2)^3}{3!} - \frac{(x - \pi/2)^5}{5!};$
$\sum_{k=0}^{\infty} (-1)^{k+1} \frac{(x - \pi/2)^{2k+1}}{(2k+1)!}$

39. $4x - \frac{(4x)^3}{3} + \frac{(4x)^5}{5}; \sum_{k=0}^{\infty} \frac{(-1)^k (4x)^{2k+1}}{2k+1}$

41. $1 + 2(x-1)^2 + \frac{2}{3}(x-1)^4; \sum_{k=0}^{\infty} \frac{4^k (x-1)^{2k}}{(2k)!}$

43. $1 + \frac{x}{3} - \frac{x^2}{9} + \cdots$ **45.** $1 - \frac{3}{2}x + \frac{3}{2}x^2 - \cdots$

47. $R_n(x) = \frac{(\sinh c + \cosh c)\, x^{n+1}}{(n+1)!}$, where c is between 0 and x;
$\lim_{n\to\infty} |R_n(x)| = |\sinh c + \cosh c| \lim_{n\to\infty} \frac{|x|^{n+1}}{(n+1)!} = 0$ because
$|x|^{n+1} \ll (n+1)!$ for any fixed value of x.

49. $\frac{1}{24}$ **51.** $\frac{1}{8}$ **53.** $\frac{1}{6}$ **55.** Approx. 0.4615 **57.** Approx. 0.3819

59. $11 - \frac{1}{11} - \frac{1}{2 \cdot 11^3} - \frac{1}{2 \cdot 11^5}$ **61.** $-\frac{1}{3} + \frac{1}{3 \cdot 3^3} - \frac{1}{5 \cdot 3^5} + \frac{1}{7 \cdot 3^7}$

63. $y = 4 + 4x + \frac{4^2}{2!}x^2 + \frac{4^3}{3!}x^3 + \cdots + \frac{4^n}{n!}x^n + \cdots = 3 + e^{4x}$

65. a. $\sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{k}$ **b.** $\sum_{k=1}^{\infty} \frac{1}{k2^k}$ **c.** $2\sum_{k=0}^{\infty} \frac{x^{2k+1}}{2k+1}$

d. $x = \frac{1}{3}; 2\sum_{k=0}^{\infty} \frac{1}{3^{2k+1}(2k+1)}$ **e.** Series in part (d)

CHAPTER 12

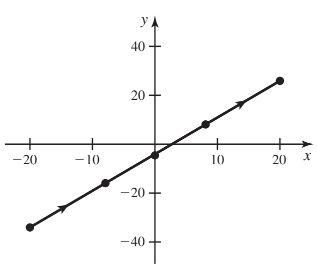
Section 12.1 Exercises, pp. 763–767

1. Plotting $\{(f(t), g(t)) : a \le t \le b\}$ generates a curve in the xy-plane. **3.** $x = R\cos(\pi t/5), y = -R\sin(\pi t/5)$ **5.** $x = t^2, y = t,$ $-\infty < t < \infty$ **7.** $-\frac{1}{2}$ **9.** $x = t, y = t, 0 \le t \le 6; x = 2t, y = 2t,$ $0 \le t \le 3; x = 3t, y = 3t, 0 \le t \le 2$ (answers will vary)

11. a.

t	-10	-4	0	4	10
x	-20	-8	0	8	20
y	-34	-16	-4	8	26

b.

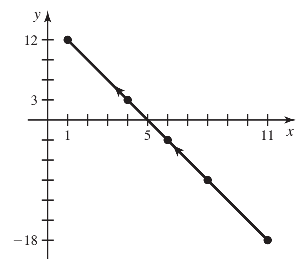


c. $y = \frac{3}{2}x - 4$
d. A line segment rising to the right as t increases

13. a.

t	-5	-2	0	2	5
x	11	8	6	4	1
y	-18	-9	-3	3	12

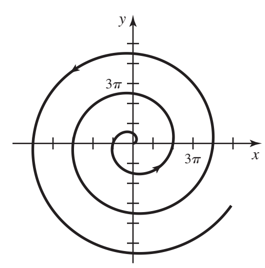
b.



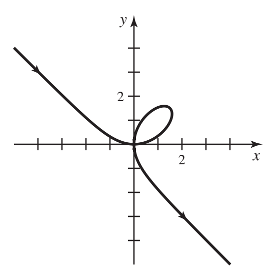
c. $y = -3x + 15$
d. A line segment rising to the left as t increases

15. a. $y = -x + 4$ **b.** A line segment starting at $(3, 1)$ and ending at $(4, 0)$ **17. a.** $y = 3x - 12$ **b.** A line segment starting at $(4, 0)$ and ending at $(8, 12)$ **19. a.** $x^2 + y^2 = 9$ **b.** Lower half of a circle of radius 3 centered at $(0, 0)$; starts at $(-3, 0)$ and ends at $(3, 0)$
21. a. $y = 1 - x^2, -1 \le x \le 1$ **b.** A parabola opening downward with a vertex at $(0, 1)$ starting at $(1, 0)$ and ending at $(-1, 0)$
23. a. $x^2 + (y-1)^2 = 1$ **b.** A circle of radius 1 centered at $(0, 1)$; generated counterclockwise, starting and ending at $(1, 1)$
25. a. $y = (x+1)^3$ **b.** A cubic curve rising to the right as r increases **27. a.** $x^2 + y^2 = 49$ **b.** A circle of radius 7 centered at $(0, 0)$; generated counterclockwise, starting and ending at $(-7, 0)$
29. a. $y = 1, -\infty < x < \infty$ **b.** A horizontal line with y-intercept 1, generated from left to right **31.** $x^2 + y^2 = 4$ **33.** $y = \sqrt{4 - x^2}$
35. $y = x^2$ **37.** $x = 4\cos t, y = 4\sin t, 0 \le t \le 2\pi$
39. $x = \cos t + 2, y = \sin t + 3, 0 \le t \le 2\pi$
41. $x = 2t, y = 8t; 0 \le t \le 1$
43. $x = t, y = 2t^2 - 4; -1 \le t \le 5$ **45.** $x = 2, y = t; 3 \le t \le 9$
47. $x = 4t - 2, y = -6t + 3; 0 \le t \le 1$ and $x = t + 1, y = 8t - 11; 1 \le t \le 2$
49. $x = 1 + 2t, y = 1 + 4t; -\infty < t < \infty$
51. $x = t^2, y = t; t \ge 0$
53. $x = 400\cos\left(\frac{4\pi t}{3}\right), y = 400\sin\left(\frac{4\pi t}{3}\right); 0 \le t \le 1.5$
55. $x = 50\cos\left(\frac{\pi t}{12}\right), y(t) = 50\sin\left(\frac{\pi t}{12}\right); 0 \le t \le 24$

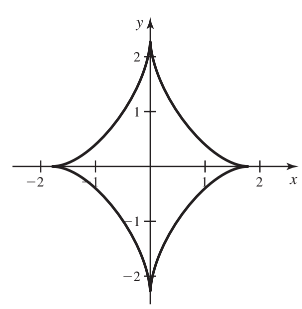
57.



59.



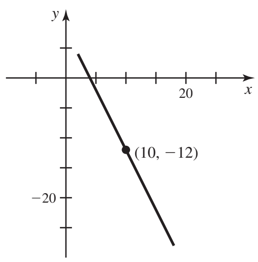
61.



63. Plot $x = 1 + \cos^2 t - \sin^2 t,$ $y = t.$
65. Approx. 2857 m

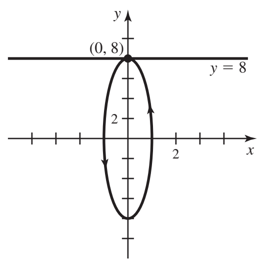
67. a. $\dfrac{dy}{dx} = -2; -2$

b.



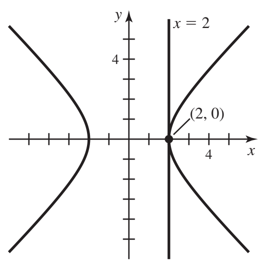
69. a. $\dfrac{dy}{dx} = -8 \cot t; 0$

b.



71. a. $\dfrac{dy}{dx} = \dfrac{t^2 + 1}{t^2 - 1}, t \neq 0;$ undefined

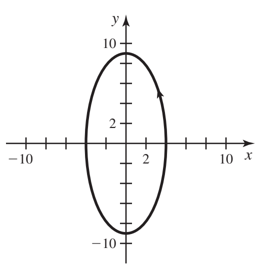
b.



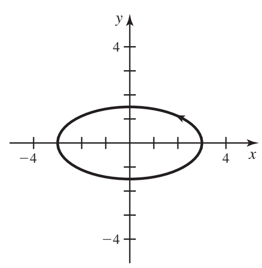
73. $y = \dfrac{13}{4}x + \dfrac{1}{4}$ **75.** $y = x - \dfrac{\pi\sqrt{2}}{4}$ **77.** $\left(-\dfrac{4}{\sqrt{5}}, \dfrac{8}{\sqrt{5}}\right)$ and $\left(\dfrac{4}{\sqrt{5}}, -\dfrac{8}{\sqrt{5}}\right)$ **79.** There is no such point. **81.** 10 **83.** $\pi\sqrt{2}$

85. $\dfrac{1}{3}(5\sqrt{5} - 8)$ **87.** $\dfrac{3}{2}$ **89. a.** False **b.** True **c.** False **d.** True **e.** True

91. $0 \le t \le 2\pi$

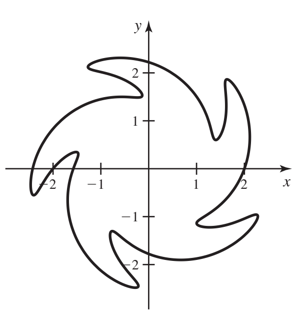


93. $x = 3\cos t, y = \dfrac{3}{2}\sin t,$ $0 \le t \le 2\pi; \left(\dfrac{x}{3}\right)^2 + \left(\dfrac{2y}{3}\right)^2 = 1;$ in the counterclockwise direction

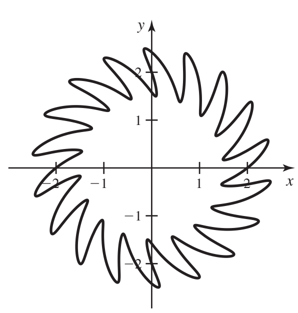


95. a. Lines intersect at $(1, 0)$. **b.** Lines are parallel. **c.** Lines intersect at $(4, 6)$.

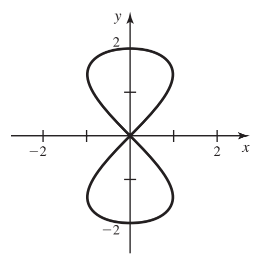
97.



99.



101.

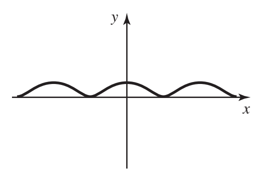


a. $(0, 2)$ and $(0, -2)$
b. $(1, \sqrt{2}), (1, -\sqrt{2}), (-1, \sqrt{2}), (-1, -\sqrt{2})$

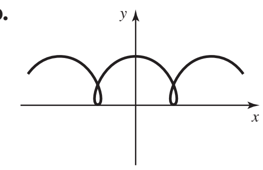
103. 27π **105.** $\dfrac{3\pi}{8}$ **107. a.** A circle of radius 3 centered at $(0, 4)$ **b.** A torus (doughnut); $48\pi^2$ **109.** $\dfrac{64\pi}{3}$

111. $\displaystyle\int_0^1 2\pi(e^{3t} + 1)\sqrt{4e^{4t} + 9e^{6t}}\,dt \approx 1445.9$

113. a.

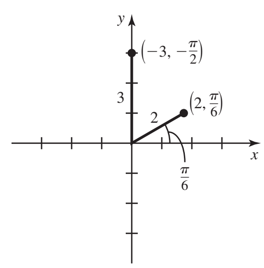


b.



Section 12.2 Exercises, pp. 775–779

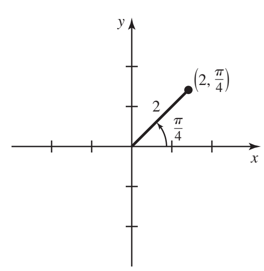
1.



$(-2, -5\pi/6), (2, 13\pi/6); (3, \pi/2), (3, 5\pi/2)$

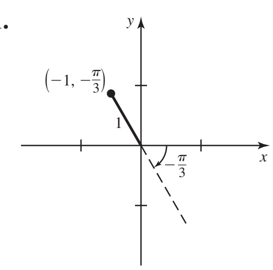
3. $r^2 = x^2 + y^2, \tan\theta = \dfrac{y}{x}$
5. $r\cos\theta = 5$ or $r = 5\sec\theta$
7. x-axis symmetry occurs if (r, θ) on the graph implies $(r, -\theta)$ is on the graph. y-axis symmetry occurs if (r, θ) on the graph implies $(r, \pi - \theta) = (-r, -\theta)$ is on the graph. Symmetry about the origin occurs if (r, θ) on the graph implies $(-r, \theta) = (r, \theta + \pi)$ is on the graph.

9.



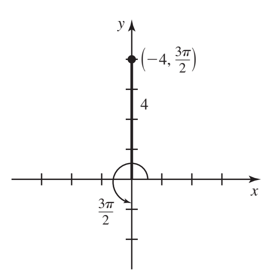
$(-2, -3\pi/4), (2, 9\pi/4)$

11.



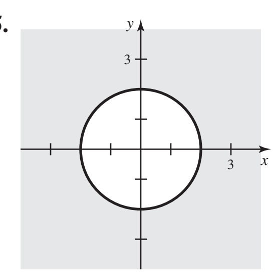
$(1, 2\pi/3), (1, 8\pi/3)$

13.

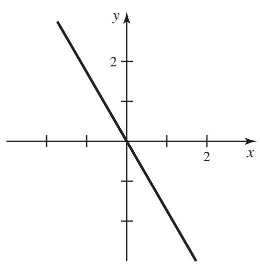


$(4, \pi/2), (4, 5\pi/2)$

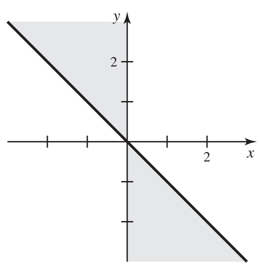
15.



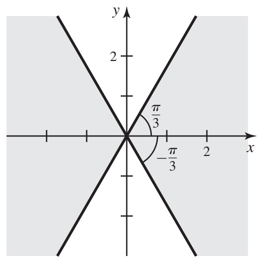
17.



19.



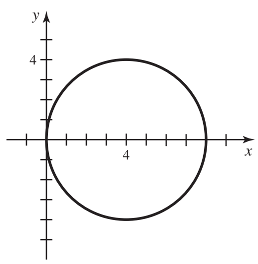
21.



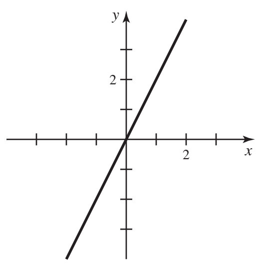
23. $\left(100, -\dfrac{\pi}{4}\right)$
25. $(3\sqrt{2}/2, 3\sqrt{2}/2)$
27. $(1/2, -\sqrt{3}/2)$
29. $(2\sqrt{2}, -2\sqrt{2})$
31. $(2\sqrt{2}, \pi/4), (-2\sqrt{2}, 5\pi/4)$
33. $(2, \pi/3), (-2, 4\pi/3)$
35. $(8, 2\pi/3), (-8, -\pi/3)$

37. $x = -4$; vertical line passing through $(-4, 0)$
39. $x^2 + y^2 = 4$; circle of radius 2 centered at $(0, 0)$
41. $(x - 1)^2 + (y - 1)^2 = 2$; circle of radius $\sqrt{2}$ centered at $(1, 1)$
43. $(x - 3)^2 + (y - 4)^2 = 25$; circle of radius 5 centered at $(3, 4)$
45. $x^2 + (y - 1)^2 = 1$; circle of radius 1 centered at $(0, 1)$ and $x = 0$ **47.** $x^2 + (y - 4)^2 = 16$; circle of radius 4 centered at $(0, 4)$
49. $r = \tan\theta \sec\theta$ **51.** $r^2 = \sec\theta \csc\theta$ or $r^2 = 2\csc 2\theta$

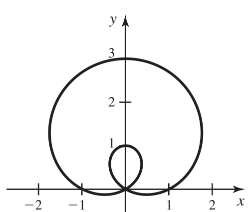
53.



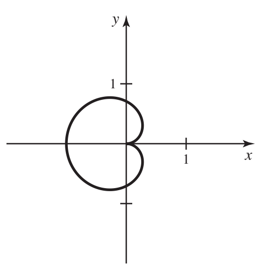
55.



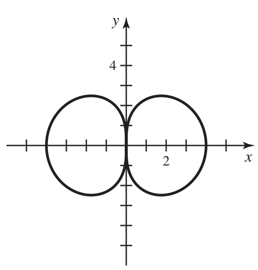
57.



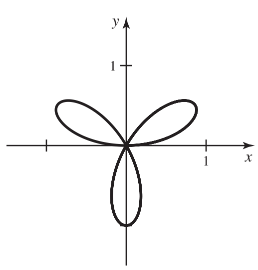
59.



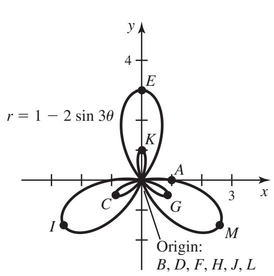
61.



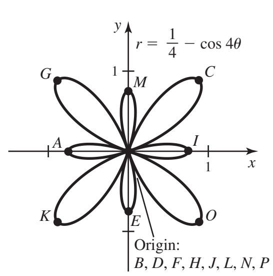
63.



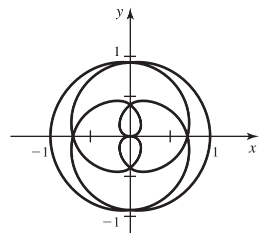
65.



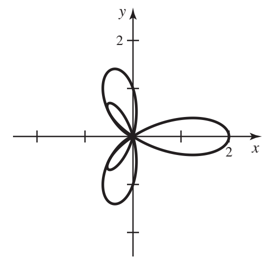
67.



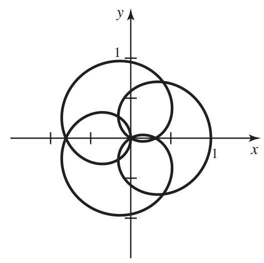
69. $[0, 8\pi]$



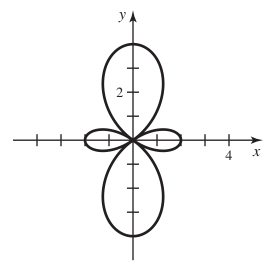
71. $[0, 2\pi]$



73. $[0, 5\pi]$

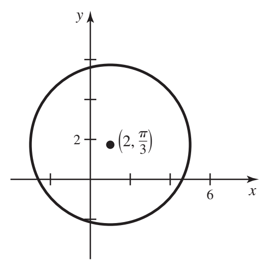


75. $[0, 2\pi]$

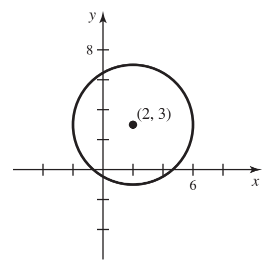


77. a. True **b.** True **c.** False **d.** True **e.** True

81. A circle of radius 4 and center $(2, \pi/3)$ (polar coordinates)

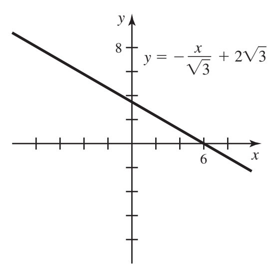


83. A circle of radius 4 centered at $(2, 3)$ (Cartesian coordinates)

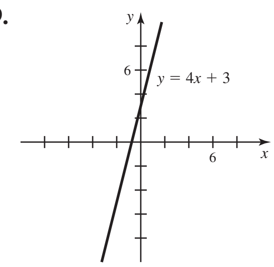


85. a. 132.3 miles **b.** 264.6 mi/hr

87.

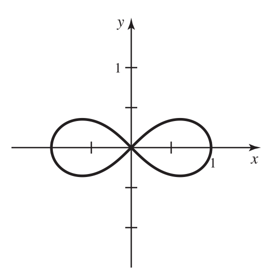


89.

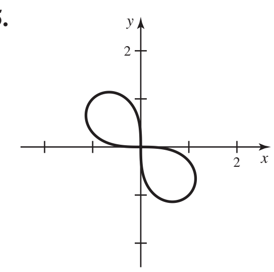


91. a. A **b.** C **c.** B **d.** D **e.** E **f.** F

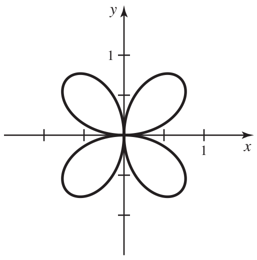
93.



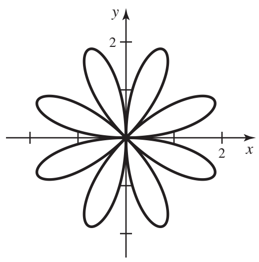
95.



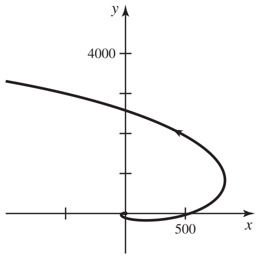
97.



99.

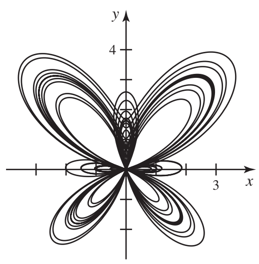


103.

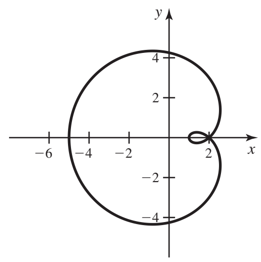


For $a = -1$, the spiral winds inward toward the origin.

105. a.



107. a.

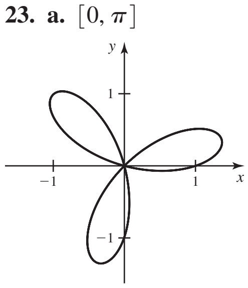


109. Symmetry about the x-axis **111.** $(x^2 + y^2)^2 = a^2(x^2 - y^2)$

Section 12.3 Exercises, pp. 786–788

1. $x = f(\theta)\cos\theta,\ y = f(\theta)\sin\theta$ **3.** The slope of the tangent line is the rate of change of the vertical coordinate with respect to the horizontal coordinate. **5.** $\sqrt{3}$ **7.** $\dfrac{\pi^2}{4}$ **9.** Both curves pass through the origin, but for different values of θ. **11.** 0 **13.** $-\sqrt{3}$
15. Undefined, undefined **17.** 0 at $(-4, \pi/2)$ and $(-4, 3\pi/2)$, undefined at $(4, 0)$ and $(4, \pi)$ **19.** ± 1 **21.** $\theta = \dfrac{3\pi}{4}$; $m = -1$

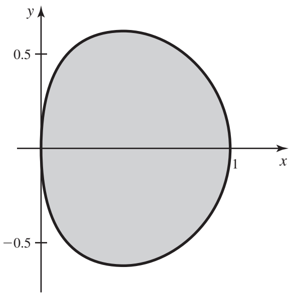
23. a. $[0, \pi]$



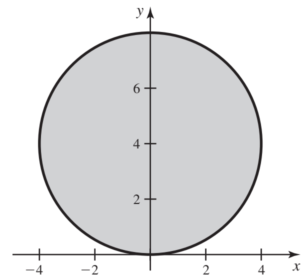
b. $\theta = \dfrac{\pi}{4}, m = 1; \theta = \dfrac{7\pi}{12}, m \approx -3.73;$ $\theta = \dfrac{11\pi}{12}, m \approx -0.27$

25. Horizontal: $(2\sqrt{2}, \pi/4)$, $(-2\sqrt{2}, 3\pi/4)$; vertical: $(0, \pi/2)$, $(4, 0)$
27. Horizontal: $(0, 0)$ $(0.943, 0.955)$, $(-0.943, 2.186)$, $(0.943, 4.097)$, $(-0.943, 5.328)$; vertical: $(0, 0)$, $(0.943, 0.615)$, $(-0.943, 2.526)$, $(0.943, 3.757)$, $(-0.943, 5.668)$ **29.** $(2, 0)$ and $(0, 0)$
31. $\left(1, \dfrac{\pi}{12}\right), \left(1, \dfrac{5\pi}{12}\right), \left(1, \dfrac{7\pi}{12}\right), \left(1, \dfrac{11\pi}{12}\right),$ $\left(1, \dfrac{13\pi}{12}\right), \left(1, \dfrac{17\pi}{12}\right), \left(1, \dfrac{19\pi}{12}\right)$, and $\left(1, \dfrac{23\pi}{12}\right)$

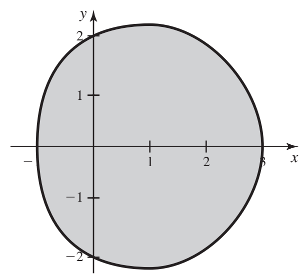
33. 1



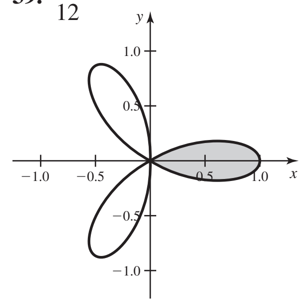
35. 16π



37. $9\pi/2$



39. $\dfrac{\pi}{12}$

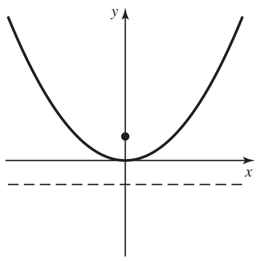


41. a. $(0, 0), \left(\dfrac{3}{\sqrt{2}}, \dfrac{\pi}{4}\right)$ **b.** $\dfrac{9}{8}(\pi - 2)$
43. a. $\left(1 + \dfrac{1}{\sqrt{2}}, \dfrac{\pi}{4}\right), \left(1 - \dfrac{1}{\sqrt{2}}, \dfrac{5\pi}{4}\right), (0, 0)$ **b.** $\dfrac{3\pi}{2} - 2\sqrt{2}$
45. $\dfrac{1}{24}(3\sqrt{3} + 2\pi)$ **47.** $\dfrac{1}{4}(2 - \sqrt{3}) + \dfrac{\pi}{12}$ **49.** $\pi/20$
51. $4(4\pi/3 - \sqrt{3})$ **53.** $2\pi/3 - \sqrt{3}/2$ **55.** $9\pi + 27\sqrt{3}$
57. 6 **59.** 18π **61.** Intersection points: $\left(3, \pm\dfrac{\pi}{3}\right)$; area of region A $= 6\sqrt{3} - 2\pi$; area of region B $= 5\pi - 6\sqrt{3}$; area of region C $= 4\pi + 6\sqrt{3}$ **63.** πa **65.** $\dfrac{8}{3}\left((1 + \pi^2)^{3/2} - 1\right)$
67. 32 **69.** $63\sqrt{5}$ **71.** $\dfrac{2\pi - 3\sqrt{3}}{8}$ **73.** 26.73
75. a. False **b.** False **c.** True
77. Horizontal: $(0, 0)$, $(4.05, 2.03)$, $(9.83, 4.91)$; vertical: $(1.72, 0.86)$, $(6.85, 3.43)$, $(12.87, 6.44)$ **79.** $\dfrac{\sqrt{1 + a^2}}{a}$
81. a. $A_n = \dfrac{1}{4e^{(4n+2)\pi}} - \dfrac{1}{4e^{4n\pi}} - \dfrac{1}{4e^{(4n-2)\pi}} + \dfrac{1}{4e^{(4n-4)\pi}}$ **b.** 0
c. $e^{-4\pi}$ **85.** $(a^2 - 2)\theta^* + \pi - \sin 2\theta^*$, where $\theta^* = \cos^{-1}(a/2)$
87. $a^2(\pi/2 + a/3)$

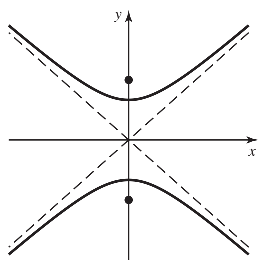
Section 12.4 Exercises, pp. 797–800

1. A parabola is the set of all points in a plane equidistant from a fixed point and a fixed line. **3.** A hyperbola is the set of all points in a plane whose distances from two fixed points have a constant difference.

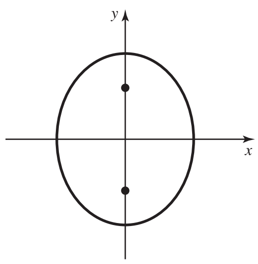
5. Parabola:



Hyperbola:

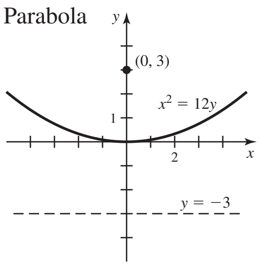


Ellipse:

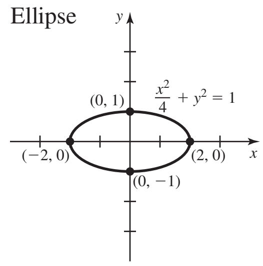


7. $\left(\dfrac{x}{a}\right)^2 + \dfrac{y^2}{a^2 - c^2} = 1$ **9.** $(\pm ae, 0)$ **11.** $y = \pm\dfrac{b}{a}x$

13. Parabola

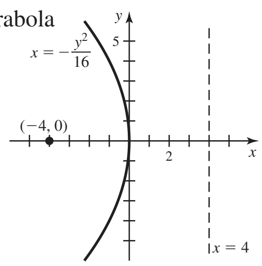


15. Ellipse

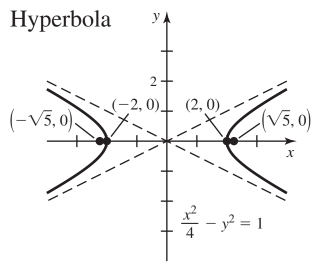


Vertices: $(\pm 2, 0)$; foci: $(\pm\sqrt{3}, 0)$; major axis has length 4; minor axis has length 2.

17. Parabola

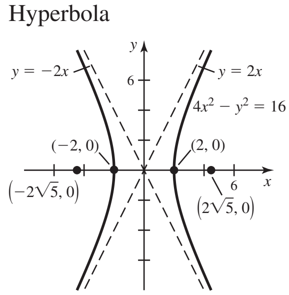


19. Hyperbola

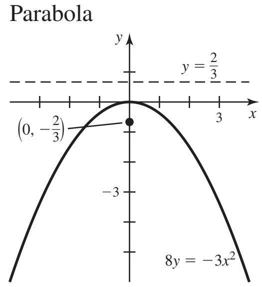


Vertices: $(\pm 2, 0)$;
foci: $(\pm\sqrt{5}, 0)$;
asymptotes: $y = \pm\dfrac{1}{2}x$

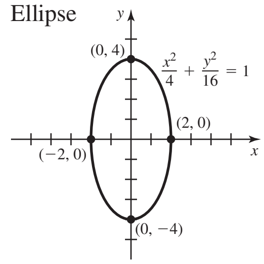
21. Hyperbola



23. Parabola

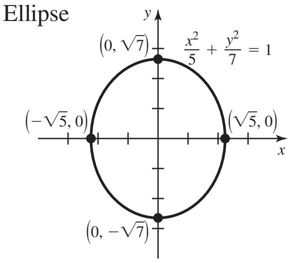


25. Ellipse



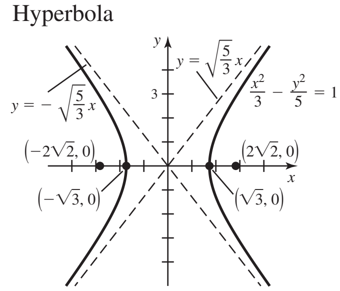
Vertices: $(0, \pm 4)$;
foci: $(0, \pm 2\sqrt{3})$; major axis has length 8; minor axis has length 4.

27. Ellipse



Vertices: $(0, \pm\sqrt{7})$; foci: $(0, \pm\sqrt{2})$; major axis has length $2\sqrt{7}$; minor axis has length $2\sqrt{5}$.

29. Hyperbola



31. $y^2 = 16x$ **33.** $y^2 = 12x$

35. $x^2 = -\dfrac{2}{3}y$

37. $y^2 = 4(x + 1)$

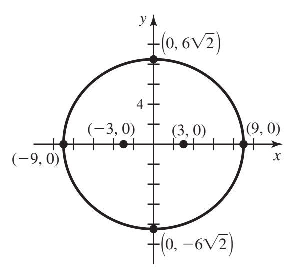
39. $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$

41. $\dfrac{x^2}{16} - \dfrac{y^2}{20} = 1$

43. $\dfrac{x^2}{25} + y^2 = 1$ **45.** $\dfrac{x^2}{4} - \dfrac{y^2}{9} = 1$ **47.** $\dfrac{x^2}{4} + \dfrac{y^2}{9} = 1$

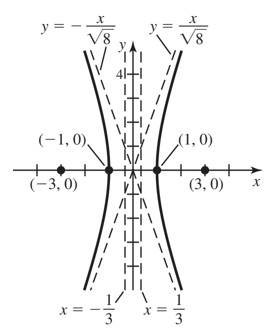
49. $\dfrac{x^2}{16} - \dfrac{y^2}{9} = 1$ **51. a.** True **b.** True **c.** True **d.** True

53. $\dfrac{x^2}{81} + \dfrac{y^2}{72} = 1$

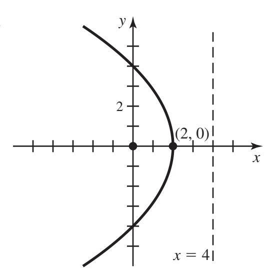


Directrices: $x = \pm 27$

55. $x^2 - \dfrac{y^2}{8} = 1$

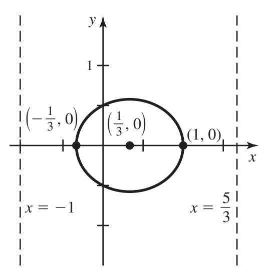


57.



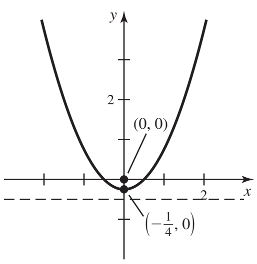
Vertex: $(2, 0)$; focus: $(0, 0)$; directrix: $x = 4$

59.



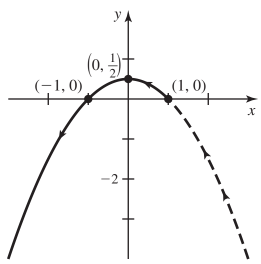
Vertices: $(1, 0), \left(-\frac{1}{3}, 0\right)$;
center: $\left(\frac{1}{3}, 0\right)$; foci: $(0, 0), \left(\frac{2}{3}, 0\right)$;
directrices: $x = -1, x = \frac{5}{3}$

61.



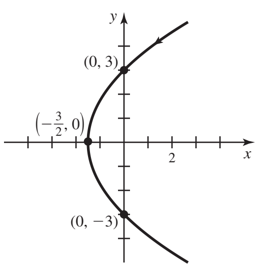
Vertex: $\left(0, -\frac{1}{4}\right)$; focus: $(0, 0)$; directrix: $y = -\frac{1}{2}$

63.



The parabola starts at $(1, 0)$ and goes through quadrants I, II, and III for θ in $[0, 3\pi/2]$; then it approaches $(1, 0)$ by traveling through quadrant IV on $(3\pi/2, 2\pi)$.

65.



The parabola begins in the first quadrant and passes through the points $(0, 3)$, $\left(-\frac{3}{2}, 0\right)$, and $(0, -3)$ as θ ranges from 0 to 2π.

67. The parabolas open to the left due to the presence of a positive $\cos\theta$ term in the denominator. As d increases, the directrix $x = d$ moves to the right, resulting in wider parabolas.

69. $y = 2x + 6$ **71.** $y = -\dfrac{3}{40}x - \dfrac{4}{5}$ **73.** $\dfrac{dy}{dx} = -\dfrac{b^2x}{a^2y}$, so $\dfrac{y - y_0}{x - x_0} = -\dfrac{b^2x_0}{a^2y_0}$, which is equivalent to the given equation.

75. $r = \dfrac{4}{1 - 2\sin\theta}$ **79.** $\dfrac{4\pi b^2 a}{3}$; $\dfrac{4\pi a^2 b}{3}$; yes, if $a \neq b$

81. a. $\dfrac{\pi b^2}{3a^2}(a - c)^2(2a + c)$ **b.** $\dfrac{4\pi b^4}{3a}$ **91.** $2p$

97. a. $u(m) = \dfrac{2m^2 - \sqrt{3m^2 + 1}}{m^2 - 1}$; $v(m) = \dfrac{2m^2 + \sqrt{3m^2 + 1}}{m^2 - 1}$; 2 intersection points for $|m| > 1$ **b.** $\dfrac{5}{4}, \infty$ **c.** 2, 2 **d.** $2\sqrt{3} - \ln(\sqrt{3} + 2)$

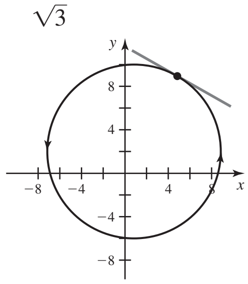
Chapter 12 Review Exercises, pp. 800–803

1. a. False **b.** False **c.** True **d.** False **e.** True **f.** True

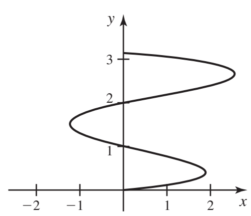
3. $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$; ellipse generated counterclockwise

5. Segment of the parabola $y = \sqrt{x}$ starting at $(4, 2)$ and ending at $(9, 3)$

7. a. $(x - 1)^2 + (y - 2)^2 = 64$ **b.** $-\dfrac{1}{\sqrt{3}}$ **c.**



9. $x = 5(t - 1)(t - 2)\sin t$, $y = t$



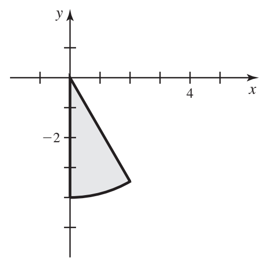
11. a. $x^2 + (y + 1)^2 = 9$ **b.** Lower half of a circle of radius 3 centered at $(0, -1)$, starting at $(3, -1)$ and ending at $(-3, -1)$ **c.** 0

13. At $t = \pi/6$: $y = (2 + \sqrt{3})x + \left(2 - \dfrac{\pi}{3} - \dfrac{\pi\sqrt{3}}{6}\right)$; at $t = \dfrac{2\pi}{3}$: $y = \dfrac{x}{\sqrt{3}} + 2 - \dfrac{2\pi}{3\sqrt{3}}$ **15.** $x = -1 + 2t, y = t$, for $0 \le t \le 1$; $x = 1 - 2t, y = 1 - t$, for $0 \le t \le 1$

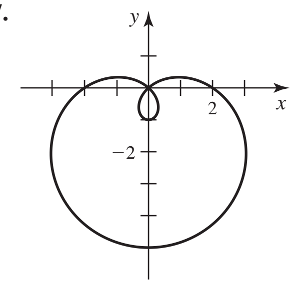
17. $x = 3\sin t, y = 3\cos t$, for $0 \le t \le 2\pi$

19. $\dfrac{4}{15}$ **21.** 9.1 **23.** $4 - 2\sqrt{2}$

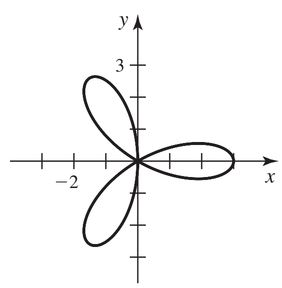
25.



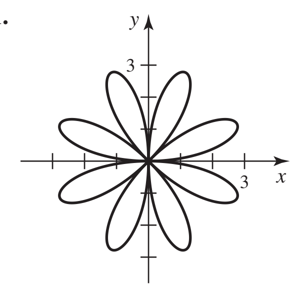
27.



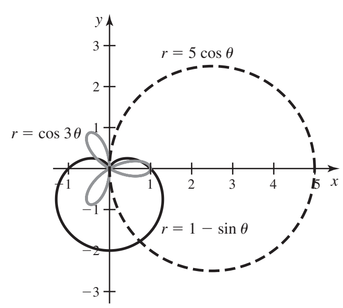
29.



31.



33. Liz should choose $r = 1 - \sin\theta$.



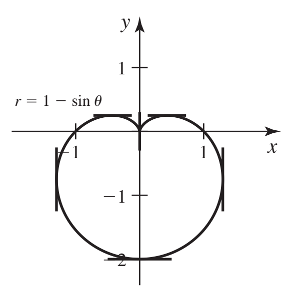
35. $(x - 3)^2 + (y + 1)^2 = 10$; a circle of radius $\sqrt{10}$ centered at $(3, -1)$

37. $r = 1 + \cos\theta$; a cardioid

39. $r = 8\cos\theta, 0 \le \theta \le \pi$

41. a. Horizontal: $\left(\dfrac{1}{2}, \dfrac{\pi}{6}\right), \left(\dfrac{1}{2}, \dfrac{5\pi}{6}\right), \left(2, \dfrac{3\pi}{2}\right)$; vertical: $\left(\dfrac{3}{2}, \dfrac{7\pi}{6}\right), \left(\dfrac{3}{2}, \dfrac{11\pi}{6}\right), \left(0, \dfrac{\pi}{2}\right)$ **b.** Undefined

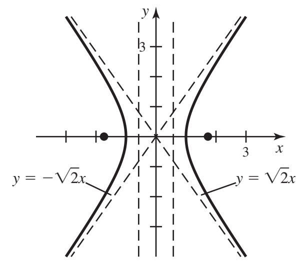
c.



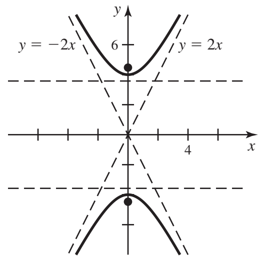
43. $\left(\dfrac{\pi}{12}, \dfrac{1}{2^{1/4}}\right), \left(\dfrac{3\pi}{4}, \dfrac{1}{2^{1/4}}\right), \left(\dfrac{17\pi}{12}, \dfrac{1}{2^{1/4}}\right), (0, 0)$

45. $\pi - \dfrac{3\sqrt{3}}{2}$ **47.** $2\sqrt{3} - \dfrac{2\pi}{3}$ **49.** 4 **51.** 40.09

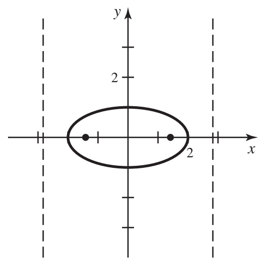
53. a. Hyperbola
b. Foci $(\pm\sqrt{3}, 0)$, vertices $(\pm 1, 0)$, directrices $x = \pm\frac{1}{\sqrt{3}}$
c. $e = \sqrt{3}$

d.


55. a. Hyperbola
b. Foci $(0, \pm 2\sqrt{5})$, vertices $(0, \pm 4)$, directrices $y = \pm\frac{8}{\sqrt{5}}$ **c.** $e = \frac{\sqrt{5}}{2}$

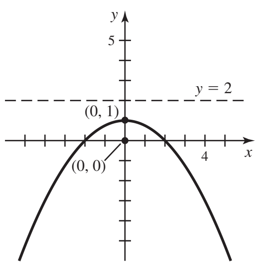
d.


57. a. Ellipse
b. Foci $(\pm\sqrt{2}, 0)$, vertices $(\pm 2, 0)$, directrices $x = \pm 2\sqrt{2}$ **c.** $e = \frac{\sqrt{2}}{2}$

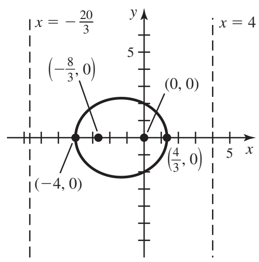
d.


59. $y = \frac{3}{2}x - 2$

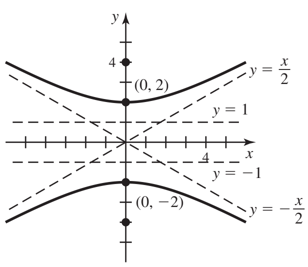
61. $e = 1$



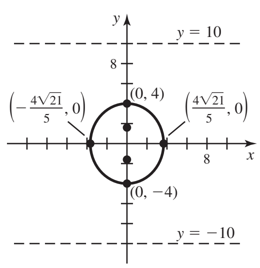
63. $e = \frac{1}{2}$



65. $\frac{y^2}{4} - \frac{x^2}{12} = 1$



67. $\frac{y^2}{16} + \frac{25x^2}{336} = 1$; foci: $\left(0, \pm\frac{8}{5}\right)$



69. $e = 2/3, y = \pm 9, (\pm 2\sqrt{5}, 0)$ **71.** $m = \frac{b}{a}$

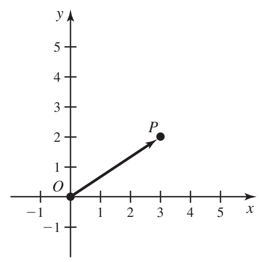
75. a. $x = \pm a\cos^{2/n} t, y = \pm b\sin^{2/n} t$
c. The curve becomes more rectangular as n increases.

CHAPTER 13

Section 13.1 Exercises, pp. 813–816

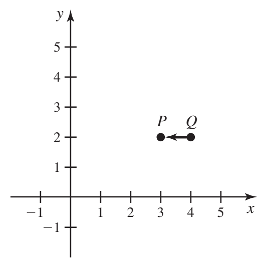
3. There are infinitely many vectors with the same direction and length as **v**. **5.** $\mathbf{u} + \mathbf{v} = \langle u_1 + v_1, u_2 + v_2 \rangle$ **7.** No **9.** $|\langle v_1, v_2 \rangle| = \sqrt{v_1^2 + v_2^2}$ **11.** If P has coordinates (x_1, y_1) and Q has coordinates (x_2, y_2), then the magnitude of $\overrightarrow{PQ}$ is given by $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. **13.** a, c, e **15. a.** $3\mathbf{v}$ **b.** $2\mathbf{u}$ **c.** $-3\mathbf{u}$ **d.** $-2\mathbf{u}$ **e.** $\mathbf{v}$ **17. a.** $3\mathbf{u} + 3\mathbf{v}$ **b.** $\mathbf{u} + 2\mathbf{v}$ **c.** $2\mathbf{u} + 5\mathbf{v}$ **d.** $-2\mathbf{u} + 3\mathbf{v}$ **e.** $3\mathbf{u} + 2\mathbf{v}$ **f.** $-3\mathbf{u} - 2\mathbf{v}$ **g.** $-2\mathbf{u} - 4\mathbf{v}$ **h.** $\mathbf{u} - 4\mathbf{v}$ **i.** $-\mathbf{u} - 6\mathbf{v}$

19. a.



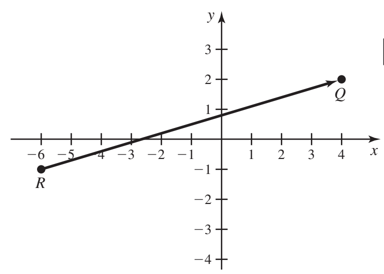
$\overrightarrow{OP} = \langle 3, 2 \rangle = 3\mathbf{i} + 2\mathbf{j}$
$|\overrightarrow{OP}| = \sqrt{13}$

b.



$\overrightarrow{QP} = \langle -1, 0 \rangle = -\mathbf{i}$
$|\overrightarrow{QP}| = 1$

c.



$\overrightarrow{RQ} = \langle 10, 3 \rangle = 10\mathbf{i} + 3\mathbf{j}$
$|\overrightarrow{RQ}| = \sqrt{109}$

21. $\overrightarrow{QU} = \langle 7, 2 \rangle, \overrightarrow{PT} = \langle 7, 3 \rangle, \overrightarrow{RS} = \langle 2, 3 \rangle$