Section 10.2

Quick Review 10.2

1. $\sqrt{17}$ **3.** $b = 5/2$ **5.** $a = 4$

7. $v(t) = \sin t + t\cos t$; $a(t) = 2\cos t - t\sin t$ **9.** 32

Exercises 10.2

1. $\langle 2, 3\rangle$ **3.** $\langle 1, -4\rangle$ **5.** $\sqrt{8}$, 45° **7.** 2, 30° **9.** 5, 180°

11. $\langle -4, 0\rangle$ **13.** $\langle -0.868, 4.924\rangle$ **15.** $\langle 3, 3\rangle$

17. (a) $\langle 9, -6\rangle$ **(b)** $3\sqrt{13}$ **19. (a)** $\langle 1, 3\rangle$ **(b)** $\sqrt{10}$

21. (a) $\langle 12, -19\rangle$ **(b)** $\sqrt{505}$ **23. (a)** $\langle 1/5, 14/5\rangle$ **(b)** $\sqrt{197}/5$

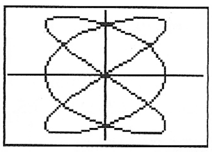
25. Speed ≈ 346.735 mph
direction ≈ 14.266° east of north

27. $\mathbf{v}(t) = \langle 6t, 6t^2\rangle$, $\mathbf{a}(t) = \langle 6, 12t\rangle$

29. $\mathbf{v}(t) = \langle e^{-t} - te^{-t}, -e^{-t}\rangle$, $\mathbf{a}(t) = \langle -2e^{-t} + te^{-t}, e^{-t}\rangle$

31. $\mathbf{v}(t) = \langle 2t + 2\cos 2t, 2t + 2\sin 2t\rangle$, $\mathbf{a}(t) = \langle 2 - 4\sin 2t, 2 + 4\cos 2t\rangle$

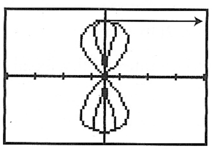
33. Velocity: $\langle -3\sin 3t, 2\cos 2t\rangle$; acceleration: $\langle -9\cos 3t, -4\sin 2t\rangle$



[−1.6, 1.6] by [−1.1, 1.1]
$0 \le t \le 2\pi$

35. (a) Velocity: $\langle 4\cos 4t\cos t - \sin t\sin 4t, 2\cos 2t\rangle|_{t=\pi/4} = \langle 2\sqrt{2}, 0\rangle$;
speed: $2\sqrt{2}$

(b)

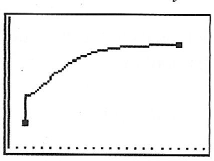


[−4, 4] by [−1.2, 1.2]
$0 \le t \le 2\pi$

(c) To the right

37. (a) (20, 9) **(b)** 19.343 **39. (a)** $(3 + \ln 4, -1.7)$ **(b)** 1.419

41. The parametric equations are
$x = t^3 - t^2 + 2$ and $y = t + \sin(\pi t)/\pi + 6$.



[0, 23] by [5, 10]
$0 \le t \le 3$

43. (a) $\pi\sqrt{7/12} \approx 2.399$ **(b)** $\langle -5\pi^2/72, -\pi^2\sqrt{3}/24\rangle$ **(c)** $\dfrac{x^2}{25} + \dfrac{y^2}{9} = 1$

45. (a) $\left\langle -\dfrac{4t}{(1+t^2)^2}, \dfrac{2-2t^2}{(1+t^2)^2}\right\rangle$

(b) No. The x-component of velocity is zero only if $t = 0$, while the y-component of velocity is zero only if $t = 1$. At no time will the velocity be $\langle 0, 0\rangle$.

(c) $\lim_{t\to\infty}\left\langle \dfrac{1-t^2}{1+t^2}, \dfrac{2t}{1+t^2}\right\rangle = \langle -1, 0\rangle$

47. (a) $\left.\dfrac{e^t\cos t - e^t\sin t}{e^t\sin t + e^t\cos t}\right|_{t=\pi/2} = -1$ **(b)** 3.844 **(c)** 2.430

49. (a) $3 + \int_2^4 (2 + \sin(t^2))\,dt \approx 3.942$ **(b)** $y - 5 = \dfrac{-6}{2 + \sin 4}(x - 3)$

(c) $\sqrt{(2 + \sin 4)^2 + (-6)^2} \approx 6.127$

(d) $\langle 8\cos 16, 2(2 + \sin 16) + 7(8)\cos 16\rangle \approx \langle -7.661, -50.205\rangle$

51. False. For example, **u** and $-1(\mathbf{u})$ have opposite directions.

53. E **55.** B

57. The velocity vector is $\langle -x, \sqrt{1 - x^2}\rangle$, which has slope $-\dfrac{\sqrt{1-x^2}}{x}$.
The acceleration vector is $\left\langle \dfrac{d}{dt}(-x), \dfrac{d}{dt}(\sqrt{1-x^2})\right\rangle$
$= \left\langle -\dfrac{dx}{dt}, \dfrac{-2x}{\sqrt{1-x^2}}\dfrac{dx}{dt}\right\rangle$
$= \left\langle x, \dfrac{x^2}{\sqrt{1-x^2}}\right\rangle$, which has slope $\dfrac{x}{\sqrt{1-x^2}}$. Since the slopes are negative reciprocals of each other, the vectors are orthogonal.

59. (a) The particles collide when $t = 2$.

(b) First particle: $\mathbf{v}_1(2) = \langle 1, -2\rangle$, so the direction unit vector is $\langle 1/\sqrt{5}, -2/\sqrt{5}\rangle$.
Second particle: $\mathbf{v}_2(t) = \langle 3/2, 3/2\rangle$, so the direction unit vector is $\langle 1/\sqrt{2}, 1/\sqrt{2}\rangle$.

61. Let $\mathbf{u} = \langle a, b\rangle$ be one of the vectors. It has slope $\dfrac{b}{a}$, so the perpendicular vector **v** must have slope $-\dfrac{a}{b}$. Thus $\mathbf{v} = \langle kb, -ka\rangle$ for some nonzero scalar k, and the dot product is $\mathbf{u}\cdot\mathbf{v} = \langle a, b\rangle \cdot \langle kb, -ka\rangle$
$= kab + (-kab) = 0$.

Section 10.3

Quick Review 10.3

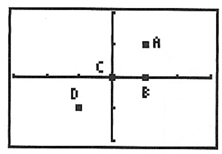
1. $\langle 2\sqrt{3}, 2\rangle$ **3.** 4π

5. Graph $y = \left(\dfrac{4 - x^2}{3}\right)^{1/2}$ and $y = -\left(\dfrac{4 - x^2}{3}\right)^{1/2}$

7. $-\dfrac{5}{3}\cot 2 \approx 0.763$ **9.** (3, 0) and (−3, 0)

Exercises 10.3

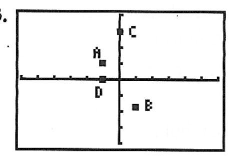
1.



[−3, 3] by [−2, 2]

(a) (1, 1) **(b)** (1, 0) **(c)** (0, 0) **(d)** (−1, −1)

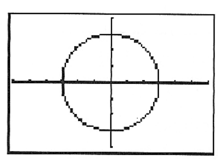
3.



[−6, 6] by [−4, 4]

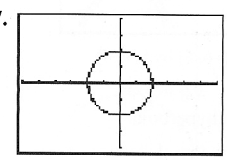
(a) $(\sqrt{2}, 3\pi/4)$ or $(\sqrt{2}, -5\pi/4)$ **(b)** $(2, -\pi/3)$ or $(-2, 2\pi/3)$
(c) $(3, \pi/2)$ or $(3, 5\pi/2)$ **(d)** $(1, \pi)$ or $(-1, 0)$

5.



[−6, 6] by [−4, 4]
$0 \le \theta \le 2\pi$

7.



[−6, 6] by [−4, 4]
$0 \le \theta \le 2\pi$