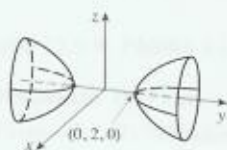
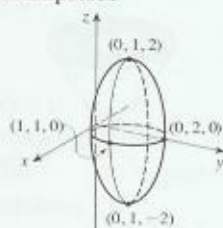


33. Hiperboloide de duas folhas



35. Elipsoide



37. $4x^2 + y^2 + z^2 = 16$

PROBLEMAS QUENTES ■ PÁGINA 776

1. $(\sqrt{3} - 1, 5) \text{ m}$

3. (a) $(x+1)/(-2c) = (y-c)/(c^2-1) = (z-c)/(c^2+1)$
(b) $x^2 + y^2 = t^2 + 1, z = t$ (c) $4\pi/3$

CAPÍTULO 13

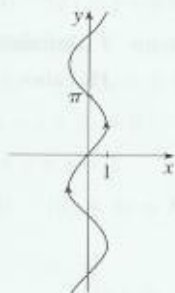
EXERCÍCIOS 13.1 ■ PÁGINA 784

1. $[1, 5]$

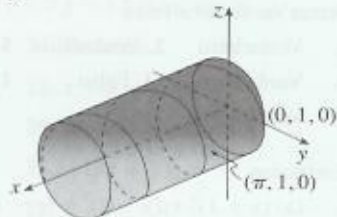
3. $\langle 1, 0, 0 \rangle$

5. $\mathbf{i} + \mathbf{j} + \mathbf{k}$

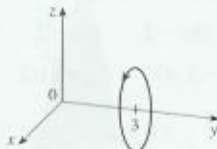
7.



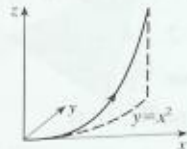
9.



11.



13.



15. $\mathbf{r}(t) = \langle t, 2t, 3t \rangle, 0 \leq t \leq 1; x = t, y = 2t, z = 3t, 0 \leq t \leq 1$

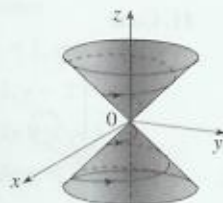
17. $\mathbf{r}(t) = \langle 3t + 1, 2t - 1, 5t + 2 \rangle, 0 \leq t \leq 1;$
 $x = 3t + 1, y = 2t - 1, z = 5t + 2, 0 \leq t \leq 1$

19. VI

21. IV

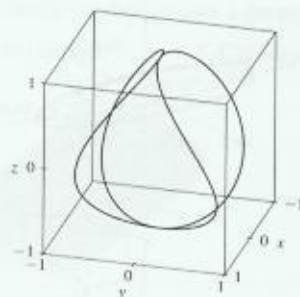
23. V

25.

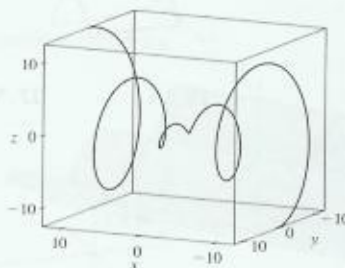


27. $(0, 0, 0), (1, 0, 1)$

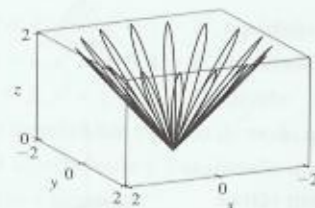
29.



31.



33.



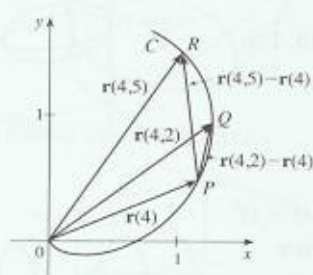
37. $\mathbf{r}(t) = t\mathbf{i} + \frac{1}{2}(t^2 - 1)\mathbf{j} + \frac{1}{2}(t^2 + 1)\mathbf{k}$

39. $x = 2 \cos t, y = 2 \sin t, z = 4 \cos^2 t$

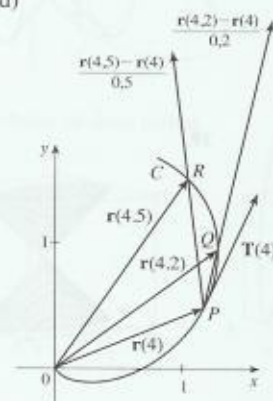
41. Sim

EXERCÍCIOS 13.2 ■ PÁGINA 789

1. (a)

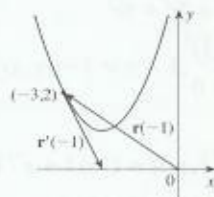


(b), (d)

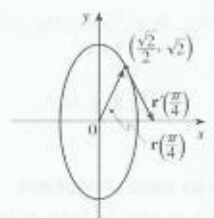


$$(c) \mathbf{r}'(4) = \lim_{h \rightarrow 0} \frac{\mathbf{r}(4+h) - \mathbf{r}(4)}{h}; \mathbf{T}(4) = \frac{\mathbf{r}'(4)}{|\mathbf{r}'(4)|}$$

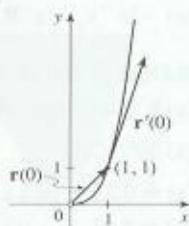
$$3. \quad (b) \mathbf{r}'(t) = \langle 1, 2t \rangle$$



$$5. (a), (c)$$



$$7. (a), (c)$$



$$(b) \mathbf{r}'(t) = \cos t \mathbf{i} - 2 \sin t \mathbf{j} \quad (b) \mathbf{r}'(t) = e^t \mathbf{i} + 3e^{3t} \mathbf{j}$$

$$9. \mathbf{r}'(t) = \langle t \cos t + \sin t, 2t, \cos 2t - 2t \sin 2t \rangle$$

$$11. \mathbf{r}'(t) = 4e^{4t} \mathbf{k}$$

$$13. \mathbf{r}'(t) = 2te^t \mathbf{i} + [3/(1+3t)] \mathbf{k}$$

$$15. \mathbf{r}'(t) = \mathbf{b} + 2t\mathbf{c}$$

$$17. \langle 15/\sqrt{262}, 6/\sqrt{262}, 1/\sqrt{262} \rangle$$

$$19. \frac{1}{5} \mathbf{j} + \frac{4}{5} \mathbf{k}$$

$$21. \langle 1, 2t, 3t^2 \rangle, \langle 1/\sqrt{14}, 2/\sqrt{14}, 3/\sqrt{14} \rangle, \langle 0, 2, 6t \rangle, \langle 6t^2, -6t, 2 \rangle$$

$$23. x = 1 + 5t, y = 1 + 4t, z = 1 + 3t$$

$$25. x = 1 - t, y = t, z = 1 - t$$

$$27. x = t, y = 1 - t, z = 2t$$

$$29. x = -\pi - t, y = \pi + t, z = -\pi t$$

$$31. 66^\circ$$

$$33. 4\mathbf{i} - 3\mathbf{j} + 5\mathbf{k}$$

$$35. \mathbf{i} + \mathbf{j} + \mathbf{k}$$

$$37. e^t \mathbf{i} + t^2 \mathbf{j} + (t \ln t - t) \mathbf{k} + \mathbf{C}$$

$$39. t^2 \mathbf{i} + t^3 \mathbf{j} + (\frac{2}{3}t^{3/2} - \frac{2}{3}) \mathbf{k}$$

$$45. 2t \cos t + 2 \sin t - 2 \cos t \sin t$$

EXERCÍCIOS 13.3 ■ PÁGINA 797

$$1. 20\sqrt{29} \quad 3. e - e^{-1} \quad 5. \frac{1}{27}(13^{3/2} - 8) \quad 7. 153841$$

$$9. 12780 \quad 11. 42$$

$$13. \mathbf{r}(t) = \frac{2}{\sqrt{29}} s \mathbf{i} + \left(1 - \frac{3}{\sqrt{29}} s\right) \mathbf{j} + \left(5 + \frac{4}{\sqrt{29}} s\right) \mathbf{k}$$

$$15. (3 \sin 1, 4, 3 \cos 1)$$

$$17. (a) \langle (2/\sqrt{29}) \cos t, 5/\sqrt{29}, (2/\sqrt{29}) \sin t \rangle, \langle -\sin t, 0, -\cos t \rangle \quad (b) \frac{2}{29}$$

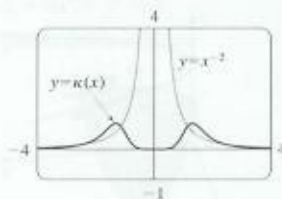
$$19. (a) \langle t^2, 2t, 2/(t^2 + 2) \rangle, \langle 2t, 2 - t^2, -2t/(t^2 + 2) \rangle \quad (b) 2/(t^2 + 2)^2$$

$$21. 2/(4t^2 + 1)^{3/2} \quad 23. \frac{4}{25} \quad 25. \frac{1}{7} \sqrt{\frac{19}{14}}$$

$$27. 2/(4x^2 - 8 + 5)^{3/2} \quad 29. 15\sqrt{x}/(1 + 100x^3)^{3/2}$$

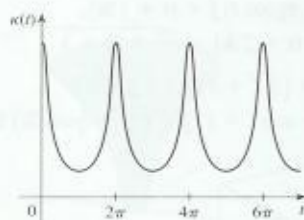
$$31. (-\frac{1}{2} \ln 2, 1/\sqrt{2}); \text{ tende a } 0 \quad 33. (a) P \quad (b) 1, 3, 0, 7$$

$$35.$$



$$37. a \text{ é } y = f(x), b \text{ é } y = \kappa(x)$$

$$39. \kappa(t) = \frac{6\sqrt{4 \cos^2 t - 12 \cos t + 13}}{(17 - 12 \cos t)^{3/2}}$$

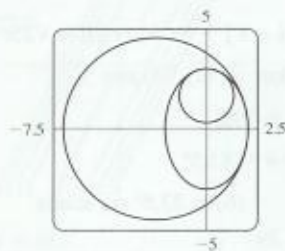


múltiplos inteiros de 2π

$$41. 1/(\sqrt{2}e^t) \quad 43. \langle \frac{2}{3}, \frac{2}{3}, \frac{1}{3} \rangle, \langle -\frac{1}{3}, \frac{2}{3}, -\frac{2}{3} \rangle, \langle -\frac{2}{3}, \frac{1}{3}, \frac{2}{3} \rangle$$

$$45. y = 6x + \pi, x + 6y = 6\pi$$

$$47. (x + \frac{5}{2})^2 + y = \frac{81}{4}, x^2 + (y - \frac{5}{3})^2 = \frac{16}{9}$$



$$49. (-1, -3, 1) \quad 57. 2/(t^6 + 4t^2 + 1)$$

$$59. 2,07 \times 10^{10} \text{ \AA} \approx 2 \text{ m}$$

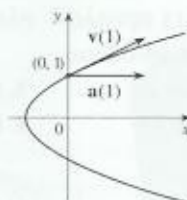
EXERCÍCIOS 13.4 ■ PÁGINA 805

$$1. (a) 1,8\mathbf{i} - 3,8\mathbf{j} - 0,7\mathbf{k}, 2,0\mathbf{i} - 2,4\mathbf{j} - 0,6\mathbf{k}, 2,8\mathbf{i} + 1,8\mathbf{j} - 0,3\mathbf{k}, 2,8\mathbf{i} + 0,8\mathbf{j} - 0,4\mathbf{k} \\ (b) 2,4\mathbf{i} - 0,8\mathbf{j} - 0,5\mathbf{k}, 2,58$$

$$3. \mathbf{v}(t) = \langle 2t, 1 \rangle$$

$$\mathbf{a}(t) = \langle 2, 0 \rangle$$

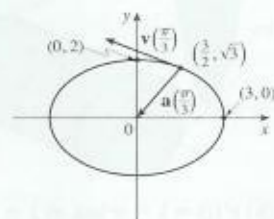
$$|\mathbf{v}(t)| = \sqrt{4t^2 + 1}$$



$$5. \mathbf{v}(t) = -3 \sin t \mathbf{i} + 2 \cos t \mathbf{j}$$

$$\mathbf{a}(t) = -3 \cos t \mathbf{i} - 2 \sin t \mathbf{j}$$

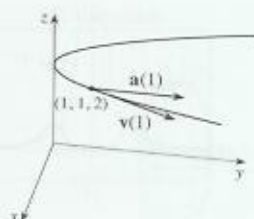
$$|\mathbf{v}(t)| = \sqrt{5 \sin^2 t + 4}$$



7. $\mathbf{v}(t) = \mathbf{i} + 2t\mathbf{j}$

$\mathbf{a}(t) = 2\mathbf{j}$

$|\mathbf{v}(t)| = \sqrt{1 + 4t^2}$



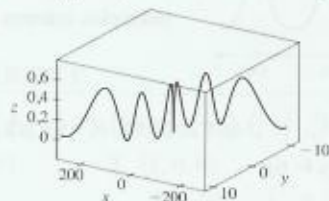
9. $\langle 1, 2t, 3t^2 \rangle, \langle 0, 2, 6t \rangle, \sqrt{1 + 4t^2 + 9t^4}$

11. $\sqrt{2}\mathbf{i} + e^t\mathbf{j} - e^{-t}\mathbf{k}, e^t\mathbf{j} + e^{-t}\mathbf{k}, e^t + e^{-t}$

13. $e^t[(\cos t - \sin t)\mathbf{i} + (\sin t + \cos t)\mathbf{j} + (t + 1)\mathbf{k}],$
 $e^t[-2\sin t\mathbf{i} + 2\cos t\mathbf{j} + (t + 2)\mathbf{k}], e^t\sqrt{t^2 + 2t + 3}$

15. $\mathbf{v}(t) = t\mathbf{i} + 2t\mathbf{j} + \mathbf{k}, \mathbf{r}(t) = (\frac{1}{2}t^2 + 1)\mathbf{i} + t^2\mathbf{j} + t\mathbf{k}$

17. (a) $\mathbf{r}(t) = (\frac{1}{3}t^3 + t)\mathbf{i} + (t - \sin t + 1)\mathbf{j} + (\frac{1}{4} - \frac{1}{4}\cos 2t)\mathbf{k}$
 (b)



19. $t = 4$

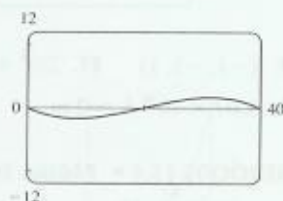
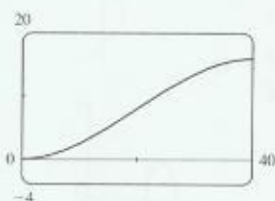
21. $\mathbf{r}(t) = t\mathbf{i} - t\mathbf{j} + \frac{5}{2}t^2\mathbf{k}, |\mathbf{v}(t)| = \sqrt{25t^2 + 2}$

23. (a) ≈ 22 km (b) $\approx 3,2$ km (c) 500 m/s

25. 30 m/s 27. $\approx 10,2, \approx 79,8$

29. $13,0^\circ < \theta < 36,0^\circ, 55,4^\circ < \theta < 85,5^\circ$

31. (a) 16 m (b) $\approx 23,6^\circ$ rio acima



33. $6t, 6$

35. 0, 1

37. $e^t - e^{-t}, \sqrt{2}$

39. $4,5 \text{ cm/s}^2, 9,0 \text{ cm/s}^2$

41. $t = 1$

CAPÍTULO 13 REVISÃO ■ PÁGINA 809

Testes Verdadeiro-Falso

1. Verdadeiro

3. Falso

5. Falso

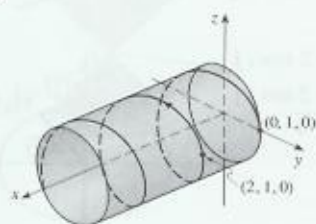
7. Verdadeiro

9. Falso

11. Verdadeiro

Exercícios

1. (a)



(b) $\mathbf{r}'(t) = \mathbf{i} - \pi \sin \pi t \mathbf{j} + \pi \cos \pi t \mathbf{k},$
 $\mathbf{r}''(t) = -\pi^2 \cos \pi t \mathbf{j} - \pi^2 \sin \pi t \mathbf{k}$

3. $\mathbf{r}(t) = 4 \cos t \mathbf{i} + 4 \sin t \mathbf{j} + (5 - 4 \cos t)\mathbf{k}, 0 \leq t \leq 2\pi$

5. $\frac{1}{3}\mathbf{i} - (2/\pi^2)\mathbf{j} + (2/\pi)\mathbf{k}$ 7. 86,631 9. $\pi/2$

11. (a) $\langle t^2, t, 1 \rangle / \sqrt{t^4 + t^2 + 1}$

(b) $\langle 2t, 1 - t^4, -2t^3 - t \rangle / \sqrt{t^8 + 4t^6 + 2t^4 + 5t^2}$

(c) $\sqrt{t^8 + 4t^6 + 2t^4 + 5t^2} / (t^4 + t^2 + 1)^2$

13. $12/17^{3/2}$

15. $x - 2y + 2\pi = 0$

17. $\mathbf{v}(t) = (1 + \ln t)\mathbf{i} + \mathbf{j} - e^{-t}\mathbf{k},$

$|\mathbf{v}(t)| = \sqrt{2 + 2 \ln t + (\ln t)^2 + e^{-2t}}, \mathbf{a}(t) = (1/t)\mathbf{i} + e^{-t}\mathbf{k}$

19. (a) Cerca de 0,8 m acima do solo, 18,4 m do atleta

(b) $\approx 6,3$ m (c) $\approx 19,1$ m do atleta

21. (c) $-2e^{-t}\mathbf{v}_d + e^{-t}\mathbf{R}$

PROBLEMAS QUENTES ■ PÁGINA 812

1. (a) $\mathbf{v} = \omega R(-\sin \omega t \mathbf{i} + \cos \omega t \mathbf{j})$ (c) $\mathbf{a} = \omega^2 \mathbf{r}$

3. (a) $90^\circ, v_0^2/(2g)$

5. (a) $\approx 0,25$ m para a direita do lado da mesa, $\approx 4,9$ m/s

(b) $\approx 5,9^\circ$ (c) $\approx 0,56$ m para a direita do lado da mesa

7. 56°

CAPÍTULO 14

EXERCÍCIOS 14.1 ■ PÁGINA 825

1. (a) -27 ; uma temperatura de -15°C com vento soprando a 40 km/h dá uma sensação equivalente a cerca de -27°C sem vento.

(b) Quando a temperatura é -20°C , qual velocidade do vento dá uma sensação térmica de -30°C ? 20 km/h

(c) Com uma velocidade do vento de 20 km/h, qual temperatura dá uma sensação térmica de -49°C ? -35°C

(d) Uma função da velocidade do vento que dá os valores da sensação térmica quando a temperatura é -5°C

(e) Uma função da temperatura que dá os valores da sensação térmica quando a velocidade do vento é 50 km/h

3. Sim

5. (a) 7,7; um vento de 80 km/h soprando em mar aberto por 15 h criará ondas de cerca de 7,7 m de altura.

(b) $f(60, t)$ é uma função de t que dá a altura das ondas produzidas por ventos de 60 km/h soprando por t horas.

(c) $f(v, 30)$ é uma função de v que dá a altura das ondas produzidas por ventos de velocidade v soprando por 30 horas.

7. (a) 4 (b) \mathbb{R}^2 (c) $[0, \infty)$

9. (a) e (b) $\{(x, y, z) | z \geq x^2 + y^2\}$ (c) $[1, \infty)$

11. $\{(x, y) | y \geq -x\}$

