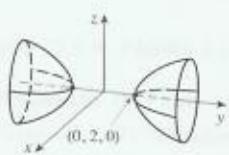


33. Hiperboloide de duas folhas



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

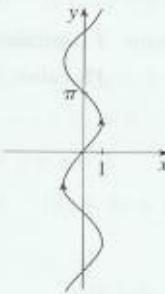
## EXERCÍCIOS 13.1 ■ PÁGINA 784

1.  $[1, 5]$

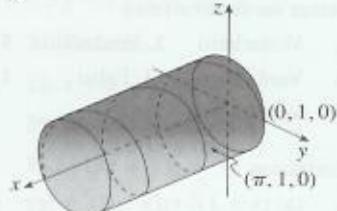
3.  $\langle 1, 0, 0 \rangle$

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

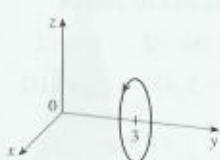
7.



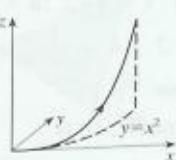
9.



11.



13.



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

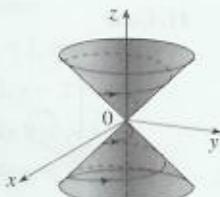
17.  $\mathbf{r}(t) = \langle 3t+1, 2t-1, 5t+2 \rangle, 0 \leq t \leq 1;$   
 $x = 3t+1, y = 2t-1, z = 5t+2, 0 \leq t \leq 1$

19. VI

21. IV

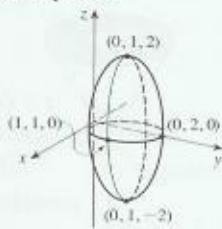
23. V

25.

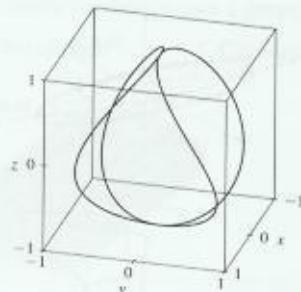


27.  $(0, 0, 0), (1, 0, 1)$

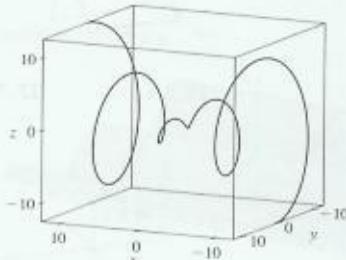
35. Elipsóide



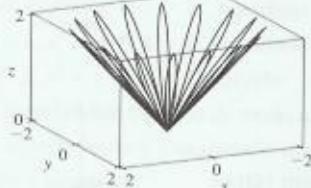
29.



31.



33.



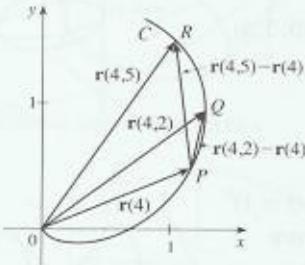
37.  $\mathbf{r}(t) = t\mathbf{i} + \frac{1}{2}(t^2 - 1)\mathbf{j} + \frac{1}{2}(t^2 + 1)\mathbf{k}$

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

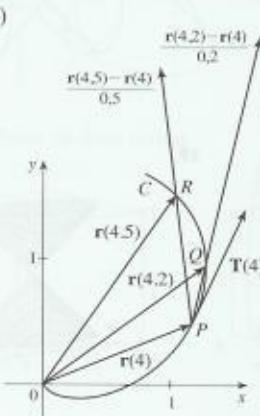
41. Sim

## EXERCÍCIOS 13.2 ■ PÁGINA 789

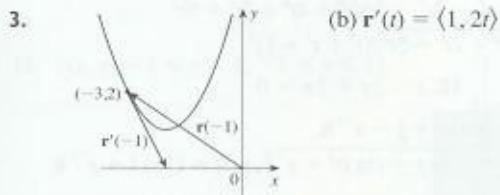
1. (a)



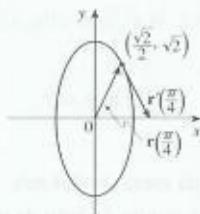
(b), (d)



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



5. (a), (c)



(b)  $\mathbf{r}'(t) = \cos t \mathbf{i} - 2 \sin t \mathbf{j}$       (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.  $\mathbf{r}'(t) = 4e^{3t} \mathbf{k}$

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.  $\frac{3}{5} \mathbf{j} + \frac{4}{5} \mathbf{k}$

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.  $t^2 \mathbf{i} + t^3 \mathbf{j} + (\frac{2}{3}t^{12} - \frac{2}{3}) \mathbf{k}$

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

### EXERCÍCIOS 13.3 ■ PÁGINA 797

1.  $20\sqrt{29}$       3.  $e - e^{-1}$       5.  $\frac{1}{27}(13^{32} - 8)$       7. 15 3841

9. 1 2780

11. 42

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

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

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

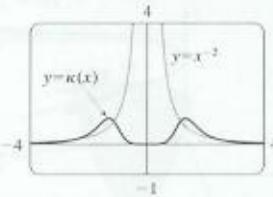
19. (a)  $\langle t^2, 2t, 2 \rangle / (t^2 + 2), \langle 2t, 2 - t^2, -2t \rangle / (t^2 + 2)$       (b)  $2 / (t^2 + 2)^2$

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

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

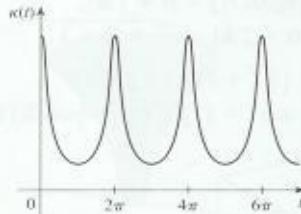
31.  $(-\frac{1}{2} \ln 2, 1/\sqrt{2});$  tende a 0      33. (a)  $P$       (b) 1, 3, 0, 7

35.



37.  $a \in y = f(x), b \in y = \kappa(x)$

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



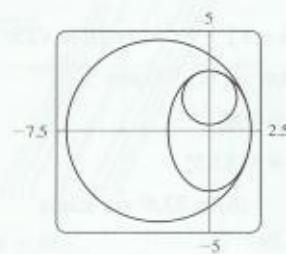
múltiplos inteiros de  $2\pi$

41.  $1/(\sqrt{2}e^t)$

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.  $(x + \frac{5}{2})^2 + y = \frac{25}{4}, x^2 + (y - \frac{2}{3})^2 = \frac{16}{9}$



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

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

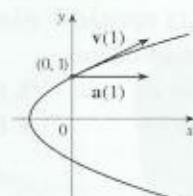
### EXERCÍCIOS 13.4 ■ PÁGINA 805

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

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

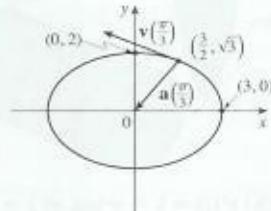
$|\mathbf{v}(t)| = \sqrt{4t^2 + 1}$



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

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

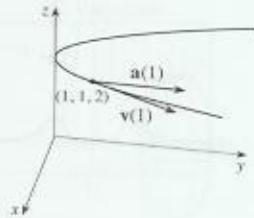
$|\mathbf{v}(t)| = \sqrt{5 \sin^2 t + 4}$



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

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

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



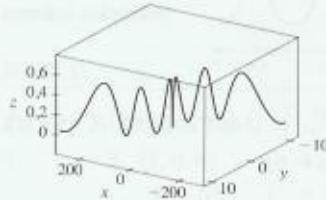
9.  $\langle 1, 2t, 3t^2 \rangle, \langle 0, 2, 6t \rangle, \sqrt{1 + 4t^2 + 9t^4}$

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.  $e'[\cos t - \sin t]\mathbf{i} + (\sin t + \cos t)\mathbf{j} + (t+1)\mathbf{k},$   
 $e'[-2 \sin t \mathbf{i} + 2 \cos t \mathbf{j} + (t+2)\mathbf{k}], e^t \sqrt{t^2 + 2t + 3}$

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

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



19.  $t = 4$

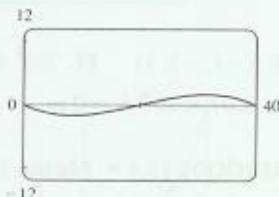
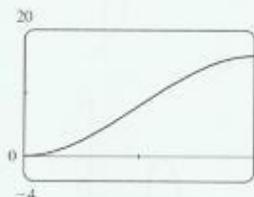
21.  $\mathbf{r}(t) = t\mathbf{i} - t\mathbf{j} + \frac{5}{2}t^2\mathbf{k}, |\mathbf{v}(t)| = \sqrt{25t^2 + 2}$

23. (a)  $\approx 22$  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

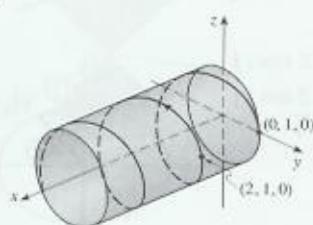
7. Verdadeiro

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.  $56^\circ$

## CAPÍTULO 14

## EXERCÍCIOS 14.1 ■ PÁGINA 825

1. (a)  $-27$ ; uma temperatura de  $-15^\circ\text{C}$  com vento soprando a  $40$  km/h dá uma sensação equivalente a cerca de  $-27^\circ\text{C}$  sem vento.

(b) Quando a temperatura é  $-20^\circ\text{C}$ , qual velocidade do vento dá uma sensação térmica de  $-30^\circ\text{C}$ ?  $20$  km/h

(c) Com uma velocidade do vento de  $20$  km/h, qual temperatura dá uma sensação térmica de  $-49^\circ\text{C}$ ?  $-35^\circ\text{C}$

(d) Uma função da velocidade do vento que dá os valores da sensação térmica quando a temperatura é  $-5^\circ\text{C}$

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

