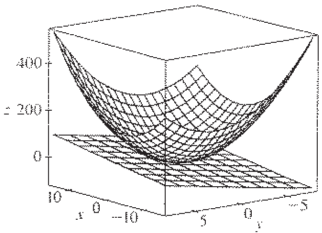
(b) $f_x(x, y) = \dfrac{x^4y + 4x^2y^3 - y^5}{(x^2 + y^2)^2}$, $f_y(x, y) = \dfrac{x^5 - 4x^3y^2 - xy^4}{(x^2 + y^2)^2}$

(c) 0, 0 (e) Não, uma vez que f_{xy} e f_{yx} não são contínuas.

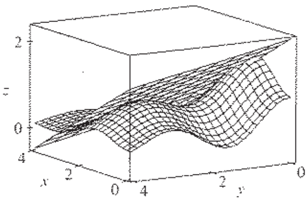
Exercícios 14.4

1. $z = -8x - 2y$ **3.** $x - 2y + z = 4$ **5.** $z = y$

7.



9.



11. $2x + \frac{1}{4}y - 1$ **13.** $x + 1$ **15.** $\frac{1}{2}x + y + \frac{1}{4}\pi - \frac{1}{2}$

17. $-\frac{2}{3}x - \frac{7}{3}y + \frac{20}{3}$; $2{,}84\overline{6}$ **19.** $\frac{3}{7}x + \frac{2}{7}y + \frac{6}{7}z$; 6,9914

21. $4T + H - 329$; 129°F

23. $dz = 3x^2 \ln(y^2)\,dx + (2x^3/y)\,dy$

25. $du = e^t \operatorname{sen} \theta\,dt + e^t \cos \theta\,d\theta$

27. $dw = (x^2 + y^2 + z^2)^{-1}(x\,dx + y\,dy + z\,dz)$

29. $\Delta z = 0{,}9225$, $dz = 0{,}9$ **31.** 5,4 cm^2 **33.** 16 cm^3

35. 150 **37.** $\frac{1}{17} \approx 0{,}059\ \Omega$ **39.** $\varepsilon_1 = \Delta x$, $\varepsilon_2 = \Delta y$

Exercícios 14.5

1. $4(2xy + y^2)t^3 - 3(x^2 + 2xy)t^2$

3. $\pi \cos x \cos y - (\operatorname{sen} x \operatorname{sen} y)/(2\sqrt{t})$

5. $e^{y/z}[2t - (x/z) - (2xy/z^2)]$

7. $\partial z/\partial s = 2x + y + xt + 2yt$, $\partial z/\partial t = 2x + y + xs + 2ys$

9. $\dfrac{\partial z}{\partial s} = \dfrac{4st + \ln t}{1 + (2x + y)^2}$, $\dfrac{\partial z}{\partial t} = \dfrac{2s^2 + s/t}{1 + (2x + y)^2}$

11. $\dfrac{\partial z}{\partial s} = e^r\left(t \cos \theta - \dfrac{s}{\sqrt{s^2 + t^2}} \operatorname{sen} \theta\right)$,

$\dfrac{\partial z}{\partial t} = e^r\left(s \cos \theta - \dfrac{t}{\sqrt{s^2 + t^2}} \operatorname{sen} \theta\right)$

13. 62 **15.** 7, 2

17. $\dfrac{\partial u}{\partial r} = \dfrac{\partial u}{\partial x}\dfrac{\partial x}{\partial r} + \dfrac{\partial u}{\partial y}\dfrac{\partial y}{\partial r}$, $\dfrac{\partial u}{\partial s} = \dfrac{\partial u}{\partial x}\dfrac{\partial x}{\partial s} + \dfrac{\partial u}{\partial y}\dfrac{\partial y}{\partial s}$,

$\dfrac{\partial u}{\partial t} = \dfrac{\partial u}{\partial x}\dfrac{\partial x}{\partial t} + \dfrac{\partial u}{\partial y}\dfrac{\partial y}{\partial t}$

19. $\dfrac{\partial v}{\partial x} = \dfrac{\partial v}{\partial p}\dfrac{\partial p}{\partial x} + \dfrac{\partial v}{\partial q}\dfrac{\partial q}{\partial x} + \dfrac{\partial v}{\partial r}\dfrac{\partial r}{\partial x}$,

$\dfrac{\partial v}{\partial y} = \dfrac{\partial v}{\partial p}\dfrac{\partial p}{\partial y} + \dfrac{\partial v}{\partial q}\dfrac{\partial q}{\partial y} + \dfrac{\partial v}{\partial r}\dfrac{\partial r}{\partial y}$,

$\dfrac{\partial v}{\partial z} = \dfrac{\partial v}{\partial p}\dfrac{\partial p}{\partial z} + \dfrac{\partial v}{\partial q}\dfrac{\partial q}{\partial z} + \dfrac{\partial v}{\partial r}\dfrac{\partial r}{\partial z}$

21. 85, 178, 54 **23.** $\frac{9}{7}, \frac{9}{7}$ **25.** 36, 24, 30

27. $\dfrac{4(xy)^{3/2} - y}{x - 2x^2\sqrt{xy}}$ **29.** $\dfrac{\operatorname{sen}(x - y) + e^y}{\operatorname{sen}(x - y) - xe^y}$

31. $\dfrac{3yz - 2x}{2z - 3xy}, \dfrac{3xz - 2y}{2z - 3xy}$

33. $\dfrac{1 + y^2z^2}{1 + y + y^2z^2}, -\dfrac{z}{1 + y + y^2z^2}$

35. 2°C/s

37. $\approx -0{,}33$ m/s por minuto

39. (a) 6 m^3/s (b) 10 m^2/s (c) 0 m/s **41.** $-0{,}27$ L/s

43. (a) $\partial z/\partial r = (\partial z/\partial x) \cos \theta + (\partial z/\partial y) \operatorname{sen} \theta$,
$\partial z/\partial \theta = -(\partial z/\partial x)r \operatorname{sen} \theta + (\partial z/\partial y)r \cos \theta$

49. $4rs\, \partial^2 z/\partial x^2 + (4r^2 + 4s^2)\partial^2 z/\partial x\, \partial y + 4rs\, \partial^2 z/\partial y^2 + 2\, \partial z/\partial y$

Exercícios 14.6

1. $\approx -0{,}1$ milibar/mi **3.** $\approx 0{,}778$ **5.** $\frac{5}{16}\sqrt{3} + \frac{1}{4}$

7. (a) $\nabla f(x, y) = \langle 5y^2 - 12x^2y, 10xy - 4x^3 \rangle$
(b) $\langle -4, 16 \rangle$ (c) 172/13

9. (a) $\langle e^{2yz}, 2xze^{2yz}, 2xye^{2yz} \rangle$ (b) $\langle 1, 12, 0 \rangle$ (c) $-\frac{22}{3}$

11. 23/10 **13.** $4\sqrt{2}$ **15.** 4/9

17. $9/(2\sqrt{5})$ **19.** 2/5 **21.** $4\sqrt{2}, \langle -1, 1 \rangle$ **23.** $1, \langle 0, 1 \rangle$

25. $\sqrt{3}, \langle 1, -1, -1 \rangle$ **27.** (b) $\langle -12, 92 \rangle$

29. Todos os pontos da reta $y = x + 1$ **31.** (a) $-40/(3\sqrt{3})$

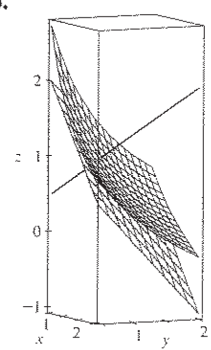
33. (a) $32/\sqrt{3}$ (b) $\langle 38, 6, 12 \rangle$ (c) $2\sqrt{406}$ **35.** $\frac{327}{13}$

39. (a) $4x - 2y + 3z = 21$ (b) $\dfrac{x - 4}{8} = \dfrac{y + 1}{-4} = \dfrac{z - 1}{6}$

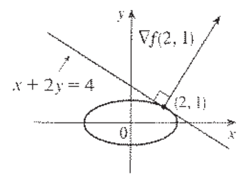
41. (a) $4x - 5y - z = 4$ (b) $\dfrac{x - 2}{4} = \dfrac{y - 1}{-5} = \dfrac{z + 1}{-1}$

43. (a) $x + y - z = 1$ (b) $x - 1 = y = -z$

45.



47. $\langle 4, 8 \rangle$, $x + 2y = 4$



53. $(\pm\sqrt{6}/3, \mp 2\sqrt{6}/3, \pm\sqrt{6}/2)$

59. $x = -1 - 10t$, $y = 1 - 16t$, $z = 2 - 12t$

63. Se $\mathbf{u} = \langle a, b \rangle$ e $\mathbf{v} = \langle c, d \rangle$, então $af_x + bf_y$ e $cf_x + df_y$ são conhecidas; logo, vamos resolver as equações lineares para f_x e f_y.