

p. 975 (12.6)

Find the gradient of the given function.

5. $f(x, y) = x^2 + 4xy^2 - y^5$

7. $f(x, y) = xe^{xy^2} + \cos y^2$

Find the gradient of the given function at the indicated point.

9. $f(x, y) = 2e^{4x/y} - 2x$, $(2, -1)$

11. $f(x, y) = \sqrt{x^2 + y^2}$, $(4, -3)$

13. $f(x, y, z) = 3x^2y - z \cos x$, $(0, 2, -1)$

Compute the directional derivative of f at the given point in the direction of the indicated vector.

15. $f(x, y) = x^2y + 4y^2$, $(2, 1)$, $\vec{u} = \left\langle \frac{1}{2}, \frac{\sqrt{3}}{2} \right\rangle$

17. $f(x, y) = x^2y + 4y^2$, $(2, 1)$, $\vec{u} = \left\langle \frac{1}{2}, -\frac{\sqrt{3}}{2} \right\rangle$

27. $f(x, y, z) = x^3yz^2 - 4xy$, $(1, -1, 2)$, \vec{u} in the direction of $\langle 2, 0, -1 \rangle$.

29. $f(x, y, z) = e^{xy+z}$, $(1, -1, 1)$, \vec{u} in the direction of $\langle 4, -2, 3 \rangle$.

Find the directions of maximum and minimum change of f at the given point, and the values of the maximum and minimum rates of change.

31. $f(x, y) = x^2 + y^3$, $(2, 1)$

33. $f(x, y) = y^2e^{4x}$, $(0, -2)$

35. $f(x, y) = x \cos 3y$, $(2, 0)$

39. $f(x, y, z) = 4x^2yz^3$, $(1, 2, 1)$

Find equations of the tangent plane and normal line to the surface at the given point.

45. $z = x^2 + y^2$ at $(1, -1, 0)$

47. $x^2 + y^2 + z^2 = 6$ at $(-1, 2, 1)$

Find all points at which the tangent plane to the surface is parallel to the xy -plane. Discuss the graphical significance of each point.

49. $z = 2x^2 - 4xy + y^4$

Sketch the path of steepest ascent from the indicated point.

51. (Image in book)

53. (Image in book)

55. (Image in book)

63. If the temperature at the point (x, y, z) is given by $T(x, y, z) = 80 + 5e^{-z}(x^{-2} + y^{-1})$, find the direction from the point $(1, 4, 8)$ in which the temperature decreases most rapidly.

64. If the temperature at the point (x, y, z) is given by $T(x, y, z) = 80 + 5e^{-z}(x^{-2} + y^{-1})$, find the direction from the point $(1, 4, 8)$ in which the temperature increases most rapidly.