4. If a point and a plane are given, find the distance from the point to the plane.

a. Find the gradient of \( f(x, y) \):

\[ \nabla f(x, y) = \left< \frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right> \]

b. Find the direction of the maximum rate of change of \( f(x, y) \) at \((a, b)\).

\[ \nabla f(a, b) = \left< \frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right> \]

\[ \left< \frac{4}{3}, \frac{4}{3} \right> \]

c. Find the smallest rate of change of \( f(x, y) \) at \((a, b)\).

\[ \frac{\partial f}{\partial x} \bigg|_{(a, b)} \]

\[ \frac{4}{3} \]

d. Find the directional derivative of \( f(x, y) \) at \((a, b)\) in the direction of \( \mathbf{v} = \langle -1, 2 \rangle \).

\[ \frac{\partial f}{\partial x} \cdot \frac{-1}{3} + \frac{\partial f}{\partial y} \cdot \frac{2}{3} \]

\[ \frac{8}{9} \]
\[\begin{align*}
\text{For } \mathbf{a} \cdot \mathbf{b} &= 0, \\
\mathbf{a} &= \langle a_1, a_2, a_3 \rangle \\
\mathbf{b} &= \langle b_1, b_2, b_3 \rangle
\end{align*}\]
\[
\begin{align*}
\mathcal{E}(x_0, y_0) &= 3 x_0 (y_0) \\
2x + 3(4x^3) &= 2x + 6x^3 \\
2x &= 3(4x^3) \\
2x &= 3(4x^3) \\
2x &= 3(4x^3)
\end{align*}
\]