



1 Let $f(x_1, x_2) = x_1 e^{x_2}$, where $x_1(t) = e^t$ and $x_2(t) = t^2$. Find the derivative of $w = f(x, y)$ with respect to t when $t = 0$, that is find $\frac{dw}{dt}|_{t=0}$.

2 Let $f(x_1, x_2) = \ln(x_1 x_2 - x_1^2)$ where $x_1(t) = t^2$ and $x_2(t) = t$. Find the derivative of $w = f(x_1, x_2)$ with respect to t when $t = 5$, that is find $\frac{dw}{dt}|_{t=5}$.

3 Find the gradient of the following functions.

(a)

$$f(x_1, x_2) = x_1(x_1^2 - x_2^2)^{2/3}$$

(b)

$$g(x_1, x_2) = \sin(3x_1^2 - 2x_2)$$

4 Let $f(x_1, x_2) = x_1^3 x_2^2$. Find the directional derivative of $f(x_1, x_2)$ in the point $(2, 3)$ and the direction $(-2, 1)^T$.

5 Let $f(x_1, x_2) = e^{x_1} \cos x_2$. In which direction does the function $f(x_1, x_2)$ increase the most in the point $(0, \pi/2)$?

6 Given the following function; find all the critical points and classify them.

(a)

$$f(x_1, x_2) = -2x_1^2 - x_2^2 + 3x_2$$

(b)

$$f(x_1, x_2) = x_1^3 - 2x_2^2 + 2x_1 x_2$$