

- 1) Sketch the domain of $f(x, y) = \log_3(9 - x^2 - y^2)$, then find $f_x(0,0)$ and $f_y(0,0)$.
- 2) Find the limit, if it exists, or show that the limit does not exist (prove your answer if exists):
 - a) $\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 + \sin^2 y}{3x^2 + y^2}$
 - b) $\lim_{(x,y) \rightarrow (0,0)} \frac{4xy}{\sqrt{x^2 + y^2}}$.
- 3) Consider the function $z = f(x, y) = x \sin(x + y)$.
 - a) Find the differential dz .
 - b) Find the equation of the tangent plane at the point where $(x, y) = (\frac{\pi}{2}, 0)$.
 - c) Use the differential or the tangent plane to approximate $f(\frac{\pi}{2} + 0.01, 0.01)$.
- 4) a) If $w = xy + yz + zx$ and $x = r \cos \theta$, $y = r \sin \theta$, $z = r\theta$, find $\frac{\partial w}{\partial \theta}$ when $(r, \theta) = (2, \frac{\pi}{2})$.
 b) If $yz + x \ln y = z^2$, find $\frac{\partial z}{\partial y}$.
- 5) Find the critical points for the function $f(x, y) = 9 - 2x + 4y - x^2 - 4y^2$ and then use the second derivative test to classify them.