

1. Determine and classify the critical point(s) of the function $f(x, y) = x^3 - x^2y + y^2 - x^2$. You must show your work. (5 points)

2. Determine the absolute maximum and the absolute minimum of the function $f(x, y) = x^2 + y^2 + x^2y - 3$ on the closed square that has vertices $(2,2)$, $(-2,2)$, $(-2,-2)$ and $(2,-2)$. You must show your work. (5 points)

3. Use the Lagrange Multiplier Method to determine the absolute maximum and the absolute minimum of the function $f(x, y) = x + y^2$ satisfying $x^2 + y^2 = 1$. (5 points)

4. Determine the critical point(s) of the function $f(x, y) = xye^{-(x^2+y^2)}$. (You do not have to classify your points). (5 points)

5. a) Show that the limit $\lim_{(x,y) \rightarrow (0,0)} \frac{x^2y}{x^4 + y^2}$ does not exist. (1 point)

b) If $z = x^2 + y^2$, $x = \cos t + \sin t$ and $y = \cos t - \sin t$, use the Chain Rule to determine $\frac{dz}{dt}$ when $t = 0$. (1.5 points)

c) Find the directional derivative of the function $f(x, y) = 2xy - 3y^2$ at the point $(5, 5)$ in the direction $(4, 3)$. (1 point)

d) Determine the cartesian equation of the tangent plane at surface given by the equation $x^2 - xy - y^2 - z = 0$ at the point $(1, 1, -1)$. (1.5 points)