

READ ME: Merely finding the answer to a problem is not enough to receive full credit; you must show how you arrived at that answer.

1) (5 points) Let

$$f(x, y) = \begin{cases} \frac{x^3y - xy^3}{x^2 + y^2}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$$

- a) Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ when $(x, y) \neq (0, 0)$.
- b) Use the definition to find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ when $(x, y) = (0, 0)$.
- c) Show that the values of $\frac{\partial^2 f}{\partial x \partial y}$ and $\frac{\partial^2 f}{\partial y \partial x}$ are not equal at $(0, 0)$. Does this say that Clairaut's Theorem is wrong? Why or why not?