

Name (print clearly): GOOD WILL HUNTING

Signature:

→ 'I'm not gonna cheat.'

1. Using the function given below, find $\frac{\partial f}{\partial x}$, $\frac{\partial f}{\partial y}$, and $\frac{\partial^2 f}{\partial x \partial y}$.

$$f(x, y) = (xe^y + y^2)^{2009}$$

$$\frac{\partial f}{\partial x} = 2009 (xe^y + y^2)^{2008} \cdot e^y$$

$$\frac{\partial f}{\partial y} = 2009 (xe^y + y^2)^{2008} (xe^y + 2y)$$

$$\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial (2009 (xe^y + y^2)^{2008})}{\partial y} \cdot e^y + 2009 (xe^y + y^2)^{2008} e^y$$

$$= 2009 \cdot 2008 \cdot (xe^y + y^2)^{2007} \cdot (xe^y + 2y) \cdot e^y$$

$$+ 2009 (xe^y + y^2)^{2008} e^y$$

2. Find a function that has the line $y = 2x + 1$ as a level curve.

$$f(x, y) = y - 2x \quad \text{has} \quad c = 1$$

$$f(x, y) = y - 2x - 1 \quad \text{has} \quad c = 0$$

$$f(x, y) = \frac{2x+1}{y} \quad \text{has} \quad c = 1, \text{ etc.}$$

3. Give an example of a function that has a critical point that is neither a relative maximum nor a relative minimum. Justify your answer.

$$f(x, y) = xy \quad \text{has} \quad \text{saddle} \quad @ \quad (0, 0)$$

$$f_x(0, 0) = 0 \quad f_y(0, 0) = 0$$

$$f_{xx} = 0 \quad f_{xy} = 1 \quad D = 0 - 1 = -1 < 0$$

$$f_{yy} = 0$$