

In the following problems you are expected to justify your answers unless stated otherwise. Answers without any explanation will be given a mark of zero. The assignment needs to be in my hand before I leave the lecture room or you will be given a zero on the assignment! **Don't forget to staple your assignment! You will lose a mark if you do not.**

1. Determine both partial derivatives of the following functions:

(a) $f(x, y) = \frac{x^2 - y^2}{x^2 + y^2}$

(b) $g(x, y) = (\cos x)^{\sin(y)}$ **Hint:** note that $g(x, y) = e^{\sin(y) \log(\cos x)}$

2. Let $f(x, y)$ be a two variable function defined on \mathbb{R}^2 , such that all the first, second and third partials are defined and continuous. Also suppose that the third order partials satisfy the following equation at the point $(-4, 3)$:

$$[f_{xyx}(-4, 3)]^2 + 5f_{yxx}(-4, 3) = 6.$$

Find all the possible values of $f_{xyx}(-4, 3)$, and **carefully state any theorem you are using**.

3. Find and classify all the critical points of

$$f(x, y) = 2x^3 + 6xy^2 - 3y^3 - 150x + e^{\sqrt{\log(\pi)}}$$

4. Find the absolute maximum and minimum of the function

$$f(x, y) = x^2 + 2y^2 - 4x,$$

on the semi-circle

$$\{(x, y) \in \mathbb{R}^2 | x^2 + y^2 \leq 16, y \geq -x\}.$$

5. Find the minimum distance from the curve $y^2x = 16$ to the origin. Clearly state what the objective function and constraint are. You must use Lagrange multipliers, a solution any other method will be given a mark of zero, even if it is correct. **Hint:** minimize the distance squared.