

NAME: _____

Problem	Points
1	/20
2	/20
3	/20
4	/20
5	/20
Total	/100

INSTRUCTIONS:

1. Answer the following 5 problems.
2. Write your answers in the space provided. If you do not have enough space, continue on the back side of the *previous* page.
3. Show all details of your work. Answers without justification will receive zero points.
4. Neither notes, books nor calculators are allowed in the exam. You may use a $3'' \times 5''$ notecard.
5. Relax. Think before (and after) doing.

1. Find the equation of (a) the tangent plane and (b) the normal line (normal to the tangent plane) to the surface at the point

$$x + y + z = e^{xyz}, \quad (0, 0, 1)$$

2. (a) Find the limit, if it exists, or show that the limit does not exist.

$$\lim_{(x,y) \rightarrow (0,0)} \frac{x^4 - 4y^2}{x^2 + 2y^2}$$

- (b) Determine the set of points at which the following function is continuous.

$$f(x, y) = \begin{cases} \frac{x^4 - 4y^2}{x^2 + 2y^2} & \text{if } (x, y) \neq (0, 0) \\ 0 & \text{if } (x, y) = (0, 0) \end{cases}$$

3. Find the maximum rate of change of

$$f(x, y) = x^2y + \sqrt{y}$$

at the point $(2, 1)$. In which direction does it occur?

4. Find the absolute maximum and minimum values of $f(x, y) = x^2 + y^2 + 4x - 4y$ on the disk $x^2 + y^2 \leq 9$.

5. Show that $u = \ln \sqrt{x^2 + y^2}$ is a solution of Laplace's equation $u_{xx} + u_{yy} = 0$.