Name:\_\_\_\_\_

June 20, 2013

Follow the instructions for each question and show enough of your work so that I can follow your thought process. If I can't read your work or answer, you will receive little or no credit!

For problems 1 and 2, determine if the following limit exists. If it does compute it, otherwise show it does not exist.

otherwise show it does not exist.

1. 
$$\lim_{(x,y)\to(0,0)} \frac{x^4-y^4}{x^2+y^2}$$

2. 
$$\lim_{(x,y)\to(0,0)} \frac{\sin(x^2+y^2)}{x^2+y^2}$$

**3**. Find the equation of the tangent plane for  $z = x \sin(x + y)$  at the point (-1, 1, 0).

4. Find the equation of the tangent plane for  $z = \ln(x - 2y)$  at the point (3, 1, 0).

5. Let  $P = \sqrt{u^2 + v^2 + w^2}$ ,  $u = xe^y$ ,  $v = ye^x$ , and  $w = e^{xy}$ . Compute the following partial derivatives:  $\frac{\partial p}{\partial x} \quad \text{and} \quad \frac{\partial p}{\partial y}$ 

**6.** Let  $N = \frac{p+q}{p+r}$ , p = u+vw, q = v+uw, and r = w+uv. Compute the following partial derivatives:

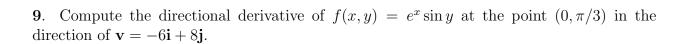
$$\frac{\partial N}{\partial u}$$
,  $\frac{\partial N}{\partial v}$ , and  $\frac{\partial N}{\partial w}$ 

7. If z = f(x, y), x = g(t), y = h(t), g(4) = 5, h(4) = 12, g'(4) = 9, h'(4) = 7,  $f_x(5, 12) = 8$ , and  $f_y(5, 12) = -7$ , compute:

$$\left. \frac{dz}{dt} \right|_{t=4}$$

8. If z = f(x, y), x = g(t), y = h(t),  $g(\pi) = 4$ ,  $h(\pi) = e$ ,  $g'(\pi) = 10$ ,  $h'(\pi) = 23$ ,  $f_x(4, e) = 2$ , and  $f_y(4, e) = 0$ , compute:

$$\left. \frac{dz}{dt} \right|_{t=z}$$



10. Compute the directional derivative of 
$$g(s,t) = te^{st}$$
 at the point  $(0,2)$  in the direction of  $\mathbf{v} = 3\mathbf{i} + 5\mathbf{j}$ .

11. Use Lagrange multipliers to find the max and min values of  $f(x,y) = x^2 + y^2$  subject to xy = 1.

12. Use Lagrange multipliers to find the max and min values of  $f(x,y) = y^2 - x^2$  subject to  $x^2 + 4y^2 = 4$ .

**13**. If z = f(t), where t = x - y show that  $\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$