Do one of Problems 4 or 5. All problems are worth 25 points. Up to 10 Bonus points can be earned by doing both 4 and 5.

For \( f(x, y) = \sqrt{9 + x^2 + y^2} \)

(a) Sketch the surface \( z = f(x, y) \).

(b) What is the direction of greatest increase in \( f(x, y) \) at when \( x = -4, y = 0 \)?

(c) What is the equation of the tangent plane to \( z = f(x, y) \) at \( (-4, 0, 5) \)?

2. For \( f(x, y) = \frac{1-e^{-x^2-y^2}}{x^2+y^2} = \frac{1-\exp(-x^2-y^2)}{x^2+y^2} \) evaluate the following:

\[
\lim_{(x, y) \to (0, 0)} f(x, y) = \text{__________________________}
\]

\[
\frac{\partial f}{\partial y} = \text{__________________________}
\]

3. Given \( f(x, y, z) = x^3 + xyz - 2z^3 \) and \( w(x, y, z) = x^2 + y^2 + z^2 \), evaluate the following:

\[
\left( \frac{\partial f}{\partial z} \right)_{y,x} = \text{__________________________}
\]

\[
\left( \frac{\partial f}{\partial z} \right)_{y,w} = \text{__________________________}
\]
4. For \( f(x, y) = e^{-y^2}(x^2 - 1) = \exp(-y^2)(x^2 - 1) \), find all critical points and determine if each critical point is a maxima, minima or saddle point.

5. Given \( f(x, y) = x^3y \) find the position(s) and the value of the \textbf{minimum} of \( f(x, y) \) on the circle of radius \( a \) centered at the origin.