1. Show that the limit below does exist. Hint: Consider a change of variables. There are also other ways of doing this . . .

\[
\lim_{(x,y,z) \to (0,0,0)} \frac{xyz}{x^2 + y^2 + z^2}
\]

2. Does the following limit exist?

\[
\lim_{(x,y,z,w) \to (0,0,0,0)} \frac{x^2 + y^2 + z^2 - w^2}{x^2 + y^2 + z^2 + w^2}
\]

3. Use the laws of limits to find

\[
\lim_{(x,y) \to (4,1)} \frac{x^2 y - 16y \sin xy^2}{x-4} \frac{y^2}{y^2}
\]

4. Discuss the continuity of the function

\[h(x, y, z) = \begin{cases} \frac{\sin x^2 - y^2}{x^2 - y^2} & \text{unless } x^2 = y^2 \\ 1 & \text{if } x^2 = y^2 \end{cases}\]

5. Suppose \( f_x(x, y) = y \) and \( f_y(x, y) = x + y \). What is \( f(x, y) \)? What about \( g_x(x, y) = x + 4y \) and \( g_y(x, y) = 3x - y \)?

6. What vector is normal to the surface \( z = f(x, y) = 5x^2 + 7y^3 + 2x + 3y + 6 \) at the point \((0, 0, 6)\)?

7. Which of the following could be the equation of the tangent plane to the surface \( z = x^2 + y^2 \) at a point \((a, b)\) in the first quadrant?

(a) \( z = -3x + 4y + 7 \)
(b) \( z = 2x - 4y + 5 \)
(c) \( z = 6x + 6y - 18 \)
(d) \( z = -4x - 4y + 24 \)

**Warm-Up for Thursday**

Let \( f(x, y, z) = e^{xyz} \). Find \( f_x, f_y, f_z \).