1. (4 points total) Let \( f(x, y) = xy\sqrt{x^2 - y^2} \).

   (a) (2 points) Find \( \nabla f \).

   (b) (2 points) Find a vector that is orthogonal to the curve \( f(x, y) = 60 \) at the point \((5, 4)\).
2. (4 points) Let $u = \langle 1, 2, -1 \rangle$. Let $f(x, y, z) = \tan^{-1}(xy) + e^{z^2 + x}$. Find the derivative of $f$ in the direction of $u$ at the point $(1, 1, 1)$.

3. (2 points) Let $f(x, y) = \tan(x^2 + 9y^2)$. Let $r(t) = \langle \cos(t), \frac{\sin(t)}{3} \rangle$. What is $\frac{df}{dt}$? (This can be done with no calculations, so qualitative explanations for your answer are allowed).