Problem 1. Determine the velocity of the path \( r(t) = (\cos^2(t), 3t - t^3, t) \) at time \( t \).

Problem 2. Let \( f(u, v) = (-e^v, u^2 - v^2) \) and \( g(x, y) = (e^{x-y}, x - y) \). Use the chain rule to calculate \( D(f \circ g)(1, 1) \).

Problem 3. Compute the directional derivative of \( f(x, y) = x^y \) at \((e, 1)\) in the direction of \((5, 12)\).

Problem 4. Compute all of the 2nd partial derivatives of \( x^2 y + xy^2 + yz^2 \).

Problem 5. Find all the critical points of \( f(x, y) = e^{1+x^2-y^2} \).

Problem 6. Find the maximum and minimum values of \( f(x, y, z) = xyz \) on the unit ball \( x^2 + y^2 + z^2 \leq 1 \).