1. (10 points) Suppose f is a smooth scalar-valued function. Let (a, b, c) be a point in the domain of f. Find the linearization $L(x, y, z)$ formula at (a, b, c).

2. (25 points) Given $z = xy^3 - x^2y$, $x = t^2 + 1$, $y = t^2 - 1$, find $\frac{dz}{dt}$.

3. Let $f(x, y)$ be a smooth scalar-valued function with gradient ∇f and $u = (u_1, u_2) \in \mathbf{R}^2$ is a unit vector.
   (a) (5 points) Write the formula for directional derivative of f in the direction of u.
   (b) (20 points) Let $f(x, y) = y^2 + x^3y$. Find the derivative in the direction of the vector $v = (1, 1)$.