1. (3 points) If $z = \ln(x^{100} + y^{100})$ where $x = s^{100}t^{100}$ and $y = s^{100} + t^{100}$, find $\frac{\partial z}{\partial s}$ and $\frac{\partial z}{\partial t}$.

2. (3 points) Using implicit differentiation, find the equation of the tangent plane at the point $(1, 1, 1)$ to the surface

$$x^{100} + x^{100}y^{200} + x^{100}y^{200}z^{300} = 3.$$  \hfill (1)
3. (4 points) Define the rate of change of the function \( w = g(s, t) \) at \((s_0, t_0)\) in the direction of the unit vector \( \vec{r} = < r_1, r_2 > \). Use the chain rule to simplify this formula. The simplified form should involve the gradient of \( g \).