1. (6) \( F(x, y, z) = e^{x-y} + \ln z - z^2 \). Consider the zero set of this function that passes through \((x_0, 1, 1)\).
   (a). Determine \( x_0 \) value and compute \( \nabla F \) at this point
   (b). Compute the tangent plane of the zero set at point \((x_0, 1, 1)\).

2. (4) \( f(x, y) = \ln(2+2x+e^y) \). Let’s say \( C \) is the level set of \( f \) passing through \((1, 0)\). Locally around \((1, 0)\), could we regard the level set \( C \) as the graph of an implicit function \( y = g(x) \)? If yes, compute \( \frac{dy}{dx}\big|_{x=1} = g'(1) \).
(Bonus: 2 pts) Consider again \( f(x, y) = \ln(2 + 2x + e^y) \) and the level set \( C \) that passes through \((1, 0)\). Compute the tangent line of \( C \) at \((1, 0)\) in two ways:

- Using \( y = g(1) + g'(1) \cdot (x - 1) \)
- Using the fact that \( \nabla f \) is perpendicular with the tangent line and
  \[ \nabla f \cdot (\vec{x} - \vec{x}_0) = 0 \]

Verify that they agree.

Comment: This is true for \( z = f(x, y) \) as well. The tangent plane computed using \( z = f(x_0, y_0) + f_x(x_0, y_0)(x - x_0) + f_y(x_0, y_0)(y - y_0) \) should agree with the tangent plane for the level set \( F(x, y, z) = f(x, y) - z = 0 \)