1. Find and sketch the domain of \( f(x, y) = \ln(9 - x^2 - 9y^2) \)

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2. Compute \( \frac{\partial f}{\partial x} \) and \( \frac{\partial f}{\partial y} \) if \( f(x, y) = \int_x^y g(t) \, dt \)

3. Show that \( u(x, y) = \arctan \left( \frac{y}{x} \right) \) satisfies Laplace's equation \( u_{xx} + u_{yy} = 0 \)

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4. Use linear approximation to estimate \( f(1.95, 1.08) \)
   if \( f(x, y) = \sqrt{20 - x^2 - 7y^2} \)

5. Suppose a function \( z = f(x, y) \) is defined implicitly by the equation \( x^2 + y^2 + z^2 = 3xyz \). Compute the partial derivatives \( \frac{\partial z}{\partial x} \) and \( \frac{\partial z}{\partial y} \) in two ways:
   a) Using standard implicit differentiation
   b) By considering the total differential of \( F(x, y, z) = x^2 + y^2 + z^2 - 3xyz \)

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6. Compute \( \frac{dw}{dt} \bigg|_{t=\pi} \) if \( w = x^2 + y^2 \), \( x = \cos t \), \( y = \sin t \)

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7. Find an equation for the path of a particle that starts at \( P(10, 10) \) and always moves in the direction of maximum temperature increase if \( T(x, y) = 400 - 2x^2 - y^2 \).

8. Show that the equation of the tangent plane to the ellipsoid \( \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1 \) at the point \((x_0, y_0, z_0)\) can be written as:
   \[ \frac{x - x_0}{a^2} + \frac{y - y_0}{b^2} + \frac{z - z_0}{c^2} = 1. \]

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