1. Find and sketch the domain of the function $f(x, y) = \ln(x - \sqrt{y})$.

2. Find the partial derivatives $f_x$, $f_y$, $f_z$, and $f_{xyz}$ of $f(x, y, z) = \frac{x y^2 - y x^2}{z}$.

3. Find the linear approximation of $f(x, y) = x + y - \sin(x^2 - 4y^2)$ at the point (2,1), and use it to estimate $f(2.01, 0.99)$.

4. Use the chain rule to find $\frac{\partial z}{\partial r}$ and $\frac{\partial z}{\partial \theta}$ for $z = e^{-x^2-y^2}$, $x = r \cos \theta$, $y = r \sin \theta$ at $r = 1, \theta = 0$. 

5. Find the directional derivative of \( f(x, y, z) = \frac{x^2 - y^4}{z} \) at \((4, 2, 1)\) in the direction of \( v = (0, 3, -4)\).

6. Find all critical points of \( f(x, y) = x^3 - 3x + y^2 \) and determine whether they are local maxima, minima, or saddle points.

7. Use Lagrange multipliers to find the maximum and minimum values of \( f(x, y) = xy \) subject to the constraint \( 2x^2 + \frac{1}{2}y^2 = 1 \).