1) a) Show that $lim_{(x,y)\to(0,0)} \frac{x^2-tan^2 y}{4x^2+y^2}$ does not exist.

b) Find the absolute maximum and absolute minimum for the function $z = f(x, y) = x + y - xy$ in the closed triangular region D with vertices $(0,0)$, $(0,2)$, and $(4,0)$.

2) For the function $f(x, y) = x^3 - 12xy + 8y^3$, find the local maximum and minimum values and saddle points if any exist.

3) Consider the function $z = f(x, y) = \sqrt{25 - x^2 - y^2}$.

   a) Find the domain and range of $f(x, y)$, and sketch it.

   b) Find $\frac{\partial z}{\partial x \partial y}$ at the point $(1,1)$.

4) a) Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if $x^4 + y^4 - 8xyz = 10$.

b) If $z = f(x^2 - y^2)$, show that $y\frac{\partial z}{\partial x} + x\frac{\partial z}{\partial y} = 0$.

5) a) Find the equation of the tangent plane to the graph of $f(x,y) = \sqrt{xy + e^{4y}}$ at the point $P(2,0)$. Then, find the linear approximation to $f(2.1,0.1)$.

b) Find the point on the cone $z = \sqrt{x^2 + y^2}$ that is closest to the point $P(1,2,0)$.