1. Suppose $f(2, 1, 1) = 4$, $f_x(2, 1, 1) = -3$, $f_y(2, 1, 1) = 2$ and $f_z(2, 1, 1) = 6$. Estimate $f(2.1, 0.9, 1.2)$.

2. Find an equation for the tangent plane to the graph of the function $f(x, y) = y^x$ at the point $(1, 2, 2)$.

3. Find the maximum and minimum values of $f(x, y, z) = x^2 + y^2 + z^2$ subject to the constraint $xyz = 4$.

4. Find the line of the form $y = mx + b$ which best fits the data points $(1, 2)$, $(3, 5)$ and $(4, 6)$ in that it minimizes the sum of the squares of the vertical distances of the data points to the line.

5. Suppose that $z$ is an implicit function of $x$ and $y$ satisfying $F(x, y, z) = 0$. Show that

$$\frac{\partial z}{\partial x} = -\frac{F_x}{F_z} \quad \text{and} \quad \frac{\partial z}{\partial y} = -\frac{F_y}{F_z}.$$ 

6. Prove the product rule for the gradient

$$\nabla(fg) = (\nabla f)g + f(\nabla g)$$

where $f$ and $g$ are functions of three variables.