Math 20550 Calculus III Tutorial **Name:** ______________________________
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# Tutorial Worksheet

Show all your work.

**1.** The height of a mountain is given by $f(x, y) = 8000 - \frac{x^2}{100} - \frac{y^2}{50}$. Suppose one is at the point $(60, 100)$. In what direction is the elevation decreasing fastest? What is the maximum rate of change of the elevation at this point?

**2.** Find the tangent plane and the normal line to the surface $x^2 + y^2 + z^2 = 3x$ at the point $P : (1, 1, 1)$. Also find the tangent line to the curve of the intersection of this surface and $2x - 3y + 5z - 4 = 0$ at $P$.

**3.** Find the local maxima, minima, and saddle points of the function $z = (x^2 + y^2)e^{-y}$.

**4.** Identify the maximum and minimum values attained by $z = x^2y - 2x^2$ within the triangle $T$ bounded by the points $P(0, 0)$, $Q(2, 0)$, and $R(0, 4)$.

**5.** Identify the maximum and minimum values attained by $z = 4x^2 - y^2 + 1$ within the region $R$ bounded by the curve $4x^2 + y^2 = 16$.

**6.** Use Lagrange multiplier to maximize $f(x, y, z) = xyz$ subject to $x^2 + 2y^2 + 3z^2 = 9$, assuming that $x$, $y$, and $z$ are nonnegative. Explain why the extremum you find is a maximum.