

Math 103.01 Summer 2001
Assignment #3
Due: Thursday, June 7, 2001

You must work through all problems on your own. You may consult any reference materials but do not discuss these problems with anyone else in the class. Show all work neatly and in order, and clearly indicate your final answers. Answers must be justified whenever possible in order to earn full credit.

- 1.** Assume that $T(x, y, z) = 10x^2 - 6xy + 2xyz$ defines a temperature distribution in space.
 - a.** Find the rate of change of T at the point $P = (3, 4, 5)$ in the direction of the vector $\mathbf{u} = (1, 1, -1)$.
 - b.** In what direction does T change most rapidly at P ?
 - c.** What is the maximal rate of change of T at P ?

- 2.** Consider the function $f(x, y) = \sqrt{1 + x^3y^2}$.
 - a.** Find the equation of the tangent plane and of the normal line to the graph $z = f(x, y)$ at the point $(2, 1)$.
 - b.** Find the directional derivative of f at $(2, 1)$ in the direction $(-1/\sqrt{5}, 2/\sqrt{5})$.

- 3.** Find and classify (as local minima, local maxima, or saddle points) all the critical points of $f(x, y) = x^3 - x + xy^2$.

- 4.** Find the maximum and minimum values of the function $f(x, y) = x^2 + y^2 - 2x + 1$ on the set $2x^2 + y^2 \leq 4$.