Math 215
Homework Set 3: §§14.3–15.4
Fall 2009

Most of the following problems are modified versions of the problems from your text book, *Multivariable Calculus*, 6th ed., by James Stewart. Your solution to each problem should be complete, show all work, and be written in complete sentences where appropriate. For *Maple* problems, include a print-out that shows all of the work and graphs that you generated in *Maple* to solve the problem, in addition to any work you may have done by hand.

15.1.1: Sketch by hand the graph of the plane $x + y + z = 3$. Draw the circle of radius one lying on the plane and centered at $(1, 1, 1)$. What is the radius of the largest circle lying on the plane and centered at $(1, 1, 1)$ that is wholly contained in the first octant? Explain.

15.1.2: Use *Maple* to investigate the family of surfaces $z = x^2 + y^2 + cxy$. In particular, find what values of c are transitional values at which the surface changes from one type of quadratic surface to another. Explain what surfaces occur on either side of the transition point.

15.3.1: You are told that there is a function f whose partial derivatives are $f_x(x, y) = x+4y$ and $f_y(x, y) = 3x - y$. Do you believe it? If so, what is the function f? If not, explain.

15.3.2: Problem #88 from §15.3.

15.4.1: Consider the surface $z = e^{-xy/10}(\sqrt{x} + \sqrt{y})$. Find the equation of the plane tangent to the surface at the point $(1, 1, 2\,e^{-0.1})$. Use *Maple* to graph the surface and the tangent plane, first on the domain $[0, 2] \times [0, 2]$ and then on a domain such that the tangent plane and the surface become indistinguishable. Explain what domains you use, and include graphs that clearly show these two cases.

15.4.2: Problem #40 from §15.4.

15.4.3: Problem #42 from §15.4.

M.2: *Maple* problem 2. Use *Maple* to graph the three-dimensional surface and the level curves for each of the following functions.

(a) $f(x, y) = \sqrt{x^2 + y^2}$,

(b) $g(x, y) = e^{-\sqrt{x^2+y^2}}$, and

(c) $h(x, y) = \sin(\sqrt{x^2 + y^2})$.

Explain how the graphs of f, g and h are related to the function $p(x) = \sqrt{x}$. Pick one of your graphs to illustrate this relationship; add to it a graph of a vector function $\mathbf{r}(t)$ whose z-component is appropriately related to $p(x)$, and hand the graph in with your homework. (Your explanation of the relationship between f, g and h and p should, of course, refer to the graph of $\mathbf{r}(t)$.)