Mathematics 221 **Spring 2004** **Project 6**

Due: March 5

______________________________ **Collaborators** ________________________ **Name**

Directions: Be sure to follow the guidelines for writing up projects as specified in the course information sheet (passed out on the first day of class). Whenever appropriate, use in-line citations, including page numbers and people consulted when you present information obtained from discussion, a text, notes, or technology. **Only write on one side of each page.**

"Thought is only a flash between two long nights, but this flash is everything." – Poincaré, Jules Henri (1854-1912)

Project Description

For this project please submit your efforts on exactly one (1) of the following. (However, you should be able to do every problem in the list.)

1. If f and all of its partial derivatives are continuous and $f_x(a,b) > 0$, $f_y(a,b) < 0$, $f_{xx}(a,b) > 0$, $f_{xy}(a,b) < 0$, $f_{yy}(a,b) > 0$, then these derivatives give us information about the shape of the surface that is the graph of $z = f(x,y)$ near $(a,b,f(a,b))$. Using the convention that the positive y-axis points to the North and the positive x-axis points to the East, carefully describe the terrain of this surface near $(a,b,f(a,b))$ as you look in the eight principle directions: N, S, E, W, NE, NW, SE, and SW.

2. Assume that $h(x,t)$, $f(x)$, and $g(x)$ are differentiable. Use chain rule methods to carefully show any function of the form
$$z = h(x,t) = f(x+at) + g(x-at)$$
is a solution of the *wave equation*
$$\frac{\partial^2 z}{\partial t^2} = a^2 \frac{\partial^2 z}{\partial x^2}.$$