# Mathematics 221 Spring 2004 Project 5

**Due: February 27**

**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.**

*"The one real object of education is to have a man in the condition of continually asking questions."* -Bishop Mandell Creighton

## 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. The graph of the function $F(x, y, z) = x^2+y^2-z^2$ is the set of points $\{(x, y, z, w) \in \mathbf{R}^4 : w = x^2 + y^2 - z^2\}$. Rather than graph this 4-dimensional object, sketch graphs of a number of level surfaces of $F$. Be sure to include the level surfaces associated with $w = -1, -1/2, 0, 1/2, 1$. Include a brief description of the following interpretation: let $w$ designate time and $x, y, z$ designate the usual three space coordinates. Describe what a movie of the function $F$ would show if we ran it from time $w = -1$ to $w = 1$.

2. Carefully explain whether or not the following limit exists. If it does exist, include its value. [In the following, $\vec{x} = \langle x, y, z\rangle$]
$$\lim_{\vec{x}\to\vec{0}} \frac{xyz^3 + 2x^4yz^2}{x^3y^3z + z^4}.$$