1. (10) (**Show all work**). Let $T(x,y,z) = x^3 + y^4 - xyz^2$. Determine whether T is increasing or decreasing at the point $(1,-2,1)$ in the direction of the vector $\mathbf{u} = (1/\sqrt{3}, -1/\sqrt{3}, -1/\sqrt{3})$.

2. (15) (**Show all work**). The level surface $G(x, y, z) = (x-2)^4 + (y-2)^4 + (z-1)^2 = 3$ and graph of $f(x, y) = 4 - x^2 - y^2$ are two surfaces which intersect at the point $(1, 1, 2)$. Determine whether or not they are tangent at that point, that is, whether they have the same tangent plane.

3. (15) (**Show all work**).

(a) Let $\mathbf{g}(x, y) = (x + y, x^2 - y^2, x^3 y)$. Find the derivative matrix $D\mathbf{g}(1, 2)$.

(b) Suppose that $\mathbf{f} : \mathbb{R}^3 \to \mathbb{R}^2$ has derivative matrix $D\mathbf{f} = \begin{pmatrix} 1 - vw & 1 - uw & 1 - uv \\ 2u & 2v & 1 \end{pmatrix}$.
With $\mathbf{g}$ as above, find $D(\mathbf{f} \circ \mathbf{g})(1, 2)$.

4. (15) (**Show all work**). Consider the path $\mathbf{c}(t) = (\sin(5t), \sqrt{3}\sin(5t), 2\cos(5t))$.

   (a) For which values of α, β, γ is $\mathbf{c}(t)$ a flowline for the vector field $\mathbf{F}(x, y, z) = (\alpha z, \beta z, \gamma x)$?

   (b) Compute the arclength of $\mathbf{c}(t)$ for t from 1 to 5.

NAME (Print!): ______________________________

Math 13

21 October 2003

First Hour Exam

Problem	Points	Score
1	10	
2	15	
3	15	
4	15	
5 (Take home)	15	
6 (Take home)	15	
7 (Take home)	15	
Total	100	