Exam 1
February 20, 2001

Name: _____

SS #: _____

Instructions:

1. There are a total of 7 problems on 8 pages. Check that your copy of the exam has all of the problems.

2. You must show all of your work to receive credit for a correct answer.

3. Your answers must be written legibly in the space provided. You may use the back of a page for additional space; please indicate clearly when you do so.

Problem	Points	Score
1	15	
2	15	
3	15	
4	20	
5	8	
6	15	
7	12	
Total	100	

Good Luck!

1. (15 points) Let $\mathbf{a} = 2\mathbf{i} - 5\mathbf{j} - \mathbf{k}$, $\mathbf{b} = 3\mathbf{i} - \mathbf{j}$, and $\mathbf{c} = \langle 1, 0, -6 \rangle$. Find each of the following:

(a) $\mathbf{a} \cdot \mathbf{c}$

(b) $\mathbf{b} \times \mathbf{c}$

(c) $\mathbf{c} \cdot \mathbf{c} - |\mathbf{c}|$

2. (15 points) Let C be the parametric curve $x = t$, $y = t^2$, $z = 3$.

(a) Find all points on the curve with $y = 4$.

(b) Find the tangent line to the curve at the point $(-1, 1, 3)$.

(c) Find the equation of the normal plane to the curve at the point $(-1, 1, 3)$.

(d) Find the speed of a particle that follows this curve.

(e) Find all points where the particle's speed is zero. Explain your answer.

3. (15 points)

(a) What is the direction of the line $x = -3 + 2t$, $y = 3$, $z = -1 + 2t$?

(b) Find parametric equations for the line through $(6, 1, -3)$ and $(-2, 1, 3)$.

(c) Find the center and radius of the sphere with equation $x^2 + y^2 + z^2 + 6x - 2y + 5 = 0$.

4. (20 points) Consider the curve $\mathbf{r}(t) = e^t \sin t\mathbf{i} + e^t \cos t\mathbf{j} + e^t\mathbf{k}$, $1 \leq t \leq 5$. Find each of the following:

(a) $\mathbf{r}'(\pi)$

(b) $\mathbf{T}(\pi)$

(c) $\mathbf{r}''(\pi)$

(d) the length of the curve

5. (8 points) Find all unit vectors that are perpendicular to both of the vectors $\mathbf{a} = 3\mathbf{i} - 3\mathbf{j} + \mathbf{k}$ and $\mathbf{b} = -\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$.

6. (15 points) Sketch the level curves of $f(x, y) = x^2 + y^2$ for $k = -1, 0, 1, 4, 9$.
   Remember to label the curves and the axes.

7. (12 points) Let $f(x,y) = 3x^2y^4 + 7\frac{x^2}{y^3}$. Find

(a) $\dfrac{\partial f}{\partial x}$

(b) $\dfrac{\partial^2 f}{\partial x^2}$

(c) f_{xy}