NAME:

1 /8	2 /9	3 /9	4 /12	5 /12	T /50

MATH 251 (Fall 2009) Exam II, Oct 30th

No calculators, books or notes! Show all work and give **complete explanations**. This is 65 min exam is worth 50 points.

(1) [8 pts] Let $\mathbf{r} : \mathbb{R} \to \mathbb{R}^3$ be the parametrized curve

$$\mathbf{r}(t) \;=\; (t^2, e^{3t}, \cos(4t))$$

and let $f : \mathbb{R}^3 \to \mathbb{R}$ be a function such that

$$f(0,1,1) = 5 \qquad\qquad f(0,3,0) = -2$$
$$\nabla f(0,1,1) = 2\mathbf{i} - 5\mathbf{j} + 7\mathbf{k} \qquad\qquad \nabla f(0,3,0) = -\mathbf{i} + 6\mathbf{j} - 3\mathbf{k}.$$

Let $g(t) = f(\mathbf{r}(t))$. Find $g'(0)$.

(2) [9 pts]
(a) Set up *but do not evaluate* an integral to calculate the length of the parametrized curve

$$\mathbf{r}(t) \;=\; (t^2, e^{3t}, \cos(4t)), \qquad 0 \le t \le \pi.$$

That is, find numbers a and b and a function F so that the length of the curve is given by $\int_a^b F(t)\,dt$.

(b) Calculate the curvature of the parametrized curve $\mathbf{r}(t) \;=\; (3+2t, 5-t^2)$ at $t=0$.

(3) [9 pts] Let $z = f(x, y)$ be a function with table of values given by

		y		
		4	5	6
x	0	7	8	5
	1	6	9	12
	2	8	11	15

Estimate $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at the point $(x, y) = (1, 5)$. Use your answer to estimate the directional derivative of f in the direction $\theta = \pi/3$ at the point $(1, 5)$.

(4) [12 pts]

(a) Sketch and describe the surface with parametrization

$$x = r\cos\theta, \qquad y = 1 - r(\cos\theta + 2\sin\theta), \qquad z = r\sin\theta$$

where $0 \le \theta \le 2\pi$ and $0 \le r \le 3$.

(b) For the surface given in (a), calculate the tangent vector to the grid curve $r = 2$ when $\theta = \pi/4$.

(5) [12 pts] Find the absolute maximum and minimum of the function $z = f(x, y) = (x + 1)^2 + y^2$ on the domain $x^2 + 4y^2 \leq 4$.

Pledge: *I have neither given nor received aid on this exam*

Signature: ________________________________