Your Name

Your Signature

Student ID #

Your TA's name

Your Quiz Section Label and Time

Problem	Points	Possible
1		10
2		8
3		6
4		10
5		16
Total		50

- No books allowed. You may use a scientific calculator and one $8\frac{1}{2} \times 11$ sheet of notes.
- Do not share notes.
- In order to receive credit, you must show your work and explain your reasoning (except on the "short answer" questions).
- **Place a box around YOUR FINAL ANSWER to each question.**
- If you need more room, use the backs of the pages and indicate to the grader where to find your work.
- Raise your hand if you have a question or need more paper.

Don't open the test until everyone has a copy and the start of the test is announced.

GOOD LUCK!

1. (10 = 2 + 3 + 5 **points**) Consider the function $f(x, y) = \ln(2x - y + 3)$.

   (a) Find and sketch the domain of this function.

   (b) Sketch two level curves of this function: one corresponding to $z = 0$ and another one to $z = 1$.

   (c) Find the linear approximation for f at $(0, 2)$ and use it to estimate the value $f(0.05, 1.93)$.

2. (**8 points**) Find and classify all critical points of the function $f(x,y) = x^3 + y^2 - 2xy$.

3. (**6 points)** For each of the following statements circle the correct answer. *No explanation of answers is needed for this problem. Be sure to explain your answers on other problems!*

   (a) The osculating plane to the curve $\mathbf{r}(t) = \langle t^3 + e^{2t}, 0, \cos(t^4)\rangle$ at the point $(1, 0, 1)$ is **the xy-plane**; **the xz-plane**; **the yz-plane**; **the $x = z$ plane**.

   (b) Let $a_N(t)$ and $a_T(t)$ be the normal and tangential components of acceleration of a certain vector function $\mathbf{r}(t)$.
   Which of the two of them can be negative? **both**; **only** a_N; **only** a_T.

   (c) Let $z = f(x,y)$ be a function of two variables such that $f_x(0,0) = f_y(0,0) = 0$, $f_{xx}(0,0) > 0$ and $f_{yy}(0,0) < 0$. Then $(0,0)$ is
   a saddle point of f; **a local minimum of** f; **a local maximum of** f.

4. (**10=4+6 points**) All the parts of this problem concern the vector function $\mathbf{r}(t)$ that satisfies the following conditions: the acceleration is $\mathbf{a}(t) = \langle \frac{1}{(t+1)^2}, 0, e^{-t} \rangle$ and the initial position and velocity are given by $\mathbf{r}(0) = \langle 0, 2, 0 \rangle$ and $\mathbf{v}(0) = \langle 0, 1, -1 \rangle$.

   (a) Compute the normal component of the acceleration vector at $t = 0$.

   (b) Find this vector function $\mathbf{r}(t)$.

5. (**16=8+8 points**)

(a) Evaluate the integral

$$\int_0^1 \int_{x^2}^1 x \cdot \sin(\pi y^2)\ dy\ dx.$$

(b) Calculate the average value of the function $f(x, y) = (x^2 + y^2)^{3/2}$ on the region in the first quadrant bounded by the lines $y = 0$ and $y = \sqrt{3}x$ and the circle $x^2 + y^2 = 9$.