NAME _____ QUIZ SECTION _____

MIDTERM II

Math 126, Section A
February 22, 2007

Problem	Total Points	Score
1	12	
2	12	
3	12	
4	14	
Total	50	
5(Bonus)	3	

- You may use a scientific calculator and one one-sided sheet of handwritten notes. No other notes, books or calculators are allowed. Please turn off your cell phone.

- Show all your work to get full credit.

- Read instructions for each problem CAREFULLY.

- Leave all your answers in EXACT form.

- Check your work!

1. (12pts) Consider the curve given by the equation in polar coordinates

$$r = 4\cos\theta + \sin\theta.$$

(a)(6pts) Find the Cartesian equation of the curve. Sketch the curve.

(b)(6pts) Find the equation of the tangent line to the curve at the point $\theta = \pi/4$.

2. (12pts) Consider the parametric curve given by the vector function $\vec{r}(t) = (t, t^2, t^3)$.
(a)(4pts) Find the equation of the normal plane to the curve at the point when $t = 1$.

Hint. The normal plane is the plane perpendicular to the tangent line.

(b)(4pts) Find the equation of the normal plane to the curve at the point $(-1, 1, -1)$.

(c)(4pts) Find the parametric equations of the line of intersection of the planes from (a) and (b).

3. (12pts) Consider the surface defined by the equation $f(x, y) = x^2y + y^3 + x$.
   (a)(6pts) Find the tangent plane to the surface at the point $(-2, 1, 3)$.

   (b)(6pts) Find all second partial derivatives of $f(x, y)$.

4. (14pts) (a)(5pts) Find the velocity and position vectors of a particle that has the acceleration vector

$$\vec{a}(t) = (2, \cos t, \sin t),$$

the initial velocity $\vec{v}(0) = \langle 0, 0, -1 \rangle$ and the initial position $\vec{r}(0) = \langle 1, 1, 0 \rangle$.

(b)(1pt) Find the position vector at the time $t = 1$.

Answer the following two questions in any order. Simplify your answers as much as possible.

(c)(4pts) Find the curvature at $t = 1$.

(d)(4pts) Find the length of the projection of the acceleration vector at $t = 1$ on the unit normal vector at $t = 1$.

5. (3pts) (*Bonus, full credit only).* Show that if a particle moves with the constant speed, then the velocity and acceleration vectors are orthogonal.