Math 126, Section D, Spring 2008, Midterm II
May 15, 2008

Instructions.

- There are 4 questions. The exam is out of 40 points.
- You are allowed to use one page of notes written only on one side of the sheet in your own handwriting.
- You may use a calculator which does not graph and which is not programmable. Even if you have a calculator, give me exact answers. \( \frac{2 \ln 3}{\pi} \) is exact, 0.7 is an approximation for the same number.
- Show your work. If I cannot read or follow your work, I cannot grade it. You may not get full credit for a right answer if your answer is not justified by your work. If you continue at the back of a page, make a note for me. Please BOX your final answer.

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1. Sketch the region bounded by

\[ z = 3x^2 + y^2 \quad \text{and} \quad z = 6 - 3x^2 - y^2 \]

and find parametric equations for the intersection of the two surfaces. (3+6 points)
2. For the curve given by
\[ \vec{r}(t) = < 4 \sin t, 3t, 4 \cos t > \]

(a) Find the unit tangent vector \( \vec{T}(t) \). (3 points)

(b) Find the unit normal vector \( \vec{N}(t) \). (3 points)
(c) Find parametric equations for the tangent line to the curve at the point \((2, \frac{\pi}{2}, 2\sqrt{3})\). (3 points)

(d) Find the equation of the normal plane to the curve at the point \((2, \frac{\pi}{2}, 2\sqrt{3})\). (3 points)
3. Sketch the graph of the curve

\[ x = e^t \cos t \quad y = e^t \sin t, \quad 0 \leq t \leq 2\pi \]

marking the \( x \) and \( y \) intercepts and find its length. (4+5 points)
4. (a) Match the following polar curves with their graphs. (1 point each)

\[
\begin{align*}
& r^2 = \sin(2\theta) & & r = \theta & & r = \cos(4\theta) \\
& r = \frac{1}{\sqrt{\theta}} & & r^2 = \cos(2\theta) & & r = \theta \sin(\theta)
\end{align*}
\]

(b) Find the equation of the tangent line to \( r = \theta \sin(\theta) \) at the point \( \left( \frac{\pi}{2}, \frac{\pi}{2} \right) \). (4 points)