MA 2733
Examination 1 – September 26, 2012

Name ______________________________

5 T/F, 2 long answer. 50 points.

General Instructions: Please answer the following, without use of calculators. You may refer to a 3x5 card, but no other notes. Correct answers without correct supporting work may not receive full credit (excluding the True/False section). You may use the back of each page for additional answer space (please clearly indicate if you have done so), or scratch work.

Mississippi State University Honor Code: "As a Mississippi State University student I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Signature ______________________________

1. True/False. Enter T or F in each blank. A correct answer is worth 2 points, a blank space is worth 0 points, and a wrong answer is worth -2 points. (Your total on this problem will be rounded up to zero if necessary.)

   (a) _____ Every curve represented as a function $y = f(x)$ can also be represented parametrically.

   (b) _____ Every curve represented as in polar coordinates as $r = g(\theta)$ can also be represented parametrically.

   (c) _____ Every curve represented parametrically as $x = r(t)$, $y = s(t)$ can also be represented as a function $y = f(x)$.

   (d) _____ If $\mathbf{v}$, and $\mathbf{u}$ are vectors, then the triple product $(\mathbf{v} + \mathbf{u}) \cdot (\mathbf{u} \times \mathbf{v})$ is always zero.

   (e) _____ If $\mathbf{v}$, $\mathbf{u}$ and $\mathbf{w}$ are vectors, then the triple product $\mathbf{w} \cdot (\mathbf{v} \times \mathbf{u})$ is always zero.

2. Parametric and polar equations

   (a) (3 points) Convert the Cartesian (i.e., (x, y)) equation $y^2 = 2x^3 + 3x^2$ into polar coordinates.

   (b) (5 points) Set up an integral for the arc length of the parametric curve given by $x = t^2$, $y = t^3$ for t on the interval $[0, 2]$. (You need not evaluate the integral.)

   (c) (8 points) Find the area of one loop of the "8-leafed rose" given by the polar equation $r = \cos(4\theta)$.

   (d) (8 points) Find all real values of t at which the parametric curve given by $x = t^2$, $y = 3t^2 - 2t^3$ has a horizontal tangent line.

3. Vectors and straight-line geometry

(a) (8 points) Give the vector equation of a straight line through the origin which is orthogonal to both of the straight lines $\mathbf{r} = t\langle 1, 2, 3\rangle$ and $\mathbf{r} = t\langle 1, 1, -1\rangle$. (At least half credit is given for finding a vector orthogonal to both lines.)

(b) (2 points) In 1-3 sentences, explain why dot products and cross products are important for geometry in 3 dimensions.

(c) (6 points) Explain why $\text{proj}_{\mathbf{u}}\,\mathbf{v} = \dfrac{\mathbf{u}\cdot\mathbf{v}}{\|\mathbf{u}\|^2}\mathbf{u}$. You may use the fact that $\mathbf{u}\cdot\mathbf{v} = \|\mathbf{u}\|\,\|\mathbf{v}\|\cos\theta$. A clear picture is by itself worth at least 2 points.