**Examination 2 - Math 142, Frank Thorne (thorne@math.sc.edu)**

**Thursday, October 24, 2013**

**Instructions and Advice:**

- There are nine questions, some of which are shorter than others.
- You are welcome to as much scratch paper as you need. Turn in everything you want graded, and throw away everything you do not want graded.
- **Draw pictures where appropriate.** If you have any doubt, then a picture is appropriate.
- Be clear, write neatly, explain what you are doing, and show your work. **This is especially important for earning partial credit** in case your work contains one or more mistakes. Be warned that **work I cannot understand will not receive any credit.**
- 75 minutes is a long time. Don't dilly-dally, but don't rush. **You are strongly advised to take the entire 75 minutes to complete the examination.** If you finish early, you have the opportunity to check your work.
- Please work without books, notes, calculators, or any assistance from others.
- I will be at the front of the room; if you have any questions, feel free to ask me.

**GOOD LUCK!**

(1) (14 points) Find the volume of a circular cone of radius 4 and height 6.

(*Warning:* You will not get credit for remembering the formula and plugging in 4 and 6. A correct answer will carry out the calculus computation. You *may* use the fact that a circle of radius $r$ has area $\pi r^2$, without further justification.)

Draw a picture illustrating your computation.

(2) (6 points) Say what it means for a curve to be defined by parametric equations. Explain why the next curve is an example.

(8 points) Sketch the curve given by the equations $x = e^{-t} + t$, $y = e^t - t$ for $-2 \leq t \leq 2$.

(8 points) In addition, find the equation of the tangent line when $t = 1$, and sketch it on your graph.

(3) (12 points) Graphs of two functions $x = f(t)$ and $y = g(t)$ are given on the next page. Use these graphs to sketch the parametric curve $x = f(t), y = g(t)$, and write a few sentences to explain what you are doing. Indicate with arrows the direction in which the curve is traced as $t$ increases.

(4) (12 points) Plot the point whose polar coordinates are $(1, -5\pi/6)$. In addition, find Cartesian coordinates of this point, and find another set of polar coordinates $(r, \theta)$ for the same point with $r < 0$.

(5) (14 points) Sketch the curve with the polar equation $r = 1 - 3\cos\theta$ for $0 \leq \theta \leq \pi/2$.

(6) A graph of the curve $r = 3 + 2\sin\theta$ is provided on the next page.

(8 points) Write down a definite integral which represents the area inside the curve.

(6 points) Estimate (by using the graph, or by other means) the numerical area inside this curve.

(12 points) Find the slope of the tangent line when $\theta = \pi/3$, and graph the tangent line on the provided graph.

(**Extra Credit.** 6 points) Find the exact area bounded by the curve.