

## NCAAPMT Calculus Challenge Problem #10

**Due: Feb. 26, 2008**

Use computer software or your calculator to sketch the graph of the curve defined by the parametric equations

$$x = \sin(t) \left( e^{\cos(t)} - 2 \cos(4t) - \sin^5\left(\frac{t}{12}\right) \right)$$
$$y = \cos(t) \left( e^{\cos(t)} - 2 \cos(4t) - \sin^5\left(\frac{t}{12}\right) \right)$$

This curve is known as a “butterfly curve”. If you need graphing software, you can download *Winplot* at <http://math.exeter.edu/rparris/>.

- The curve is periodic. The graph will simply continue to travel over itself repeatedly. What is the period of this curve? (1 pt)
- How many times does the curve pass through the origin in one complete period? (1 pt)
- Write the equation of the line tangent to the curve at  $t = 135\pi$ . (2 pts)
- Modify the equations by changing the power on the  $\sin\left(\frac{t}{12}\right)$  term, the coefficient in  $\cos(4t)$ , and the coefficient of the  $\sin\left(\frac{t}{12}\right)$  term. Which has the greatest effect on the shape of the curve? Find the variation you like the most, color it and submit it with your solution. (1 pt)