LB 220, Sections 001 & 002, Fall 2015
Homework 3 (due 9/25)

Instructions: Please write your solutions to the problems below on a clean piece of paper (not this piece of paper). You will not need more than one page (front and back) to write your answers. Show the steps taken to arrive at each answer. Do not include scratch work, doodles, scribbles, crossed out work, etc.; instead, carefully write your solutions after you have figured out the answers and checked them over.

Special Instructions For This Homework. You may the second problem on this assignment as part of a group of up to four students. Each student in the group will receive the same score for the second problem. You should turn in only one solution to the problem and sign each of your names on this single solution. You still need to do the first problem individually, although, as always, you are welcome to work on problems with others and then write up a solution on your own.

1. Determine parametric equations for the line tangent to the curve traced by the vector-valued function

$$\mathbf{r}(t) = \langle \sin(2t), 3\cos(2t), \tan t \rangle$$

   at the point where $t = \pi/4$.

2. Consider the curve traced by the following vector-valued function:

$$\mathbf{r}(t) = \langle 2\cos t + \cos(2t), 2\sin t - \sin(2t) \rangle, \quad 0 \leq t \leq 2\pi.$$

   (a) Sketch the curve by computing the exact values of $\mathbf{r}(t)$ when $t = \frac{k\pi}{3}$ for $k = 0, 1, \ldots, 6$ and plotting these points.

   (b) Compute $\|\mathbf{r}(t)\|^2$ and explain why

$$1 \leq \|\mathbf{r}(t)\| \leq 3.$$

   (c) For which values of t does $\|\mathbf{r}(t)\| = 1$? For which values of t does $\|\mathbf{r}(t)\| = 3$?

(d) You can find a sketch of this curve by clicking on the following link:

`https://en.wikipedia.org/wiki/Hypocycloid`.

It is the curve traced out in red by the animation at the top of the page.

Create a second sketch of the curve by imitating the animation: build a circular disk and roll it around the inside of a circle which has twice the radius of the disk you built. Watching the animation should make these instructions more clear. Please ask for help if you are not sure what you are supposed to do.

(e) (Bonus 1 point) Explain why the curve in the animation is the same as the curve traced by $\mathbf{r}(t)$ as t ranges from 0 to 2π.