Math 2110-003 Worksheet 1: Chpt. 13 **Name:** ____________________________ **Due:** 11/1/2017

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# Vector-valued functions part 1

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1. Give a vector function for each of the following curves, including the appropriate range of $t$-values.
   (a) A circle in the plane $x = 4$ centered at $(4, 0, 0)$ with radius 3, traced once.
   (b) The portion of the curve in the $xy$-plane with equation $y = \sqrt{x+1}$ from $(0, 1, 0)$ to $(3, 2, 0)$.
   (c) The portion of the curve in the plane $y = -1$ with equation $x = z^2 - z + 2$ from $(2, -1, 1)$ to $(8, -1, 3)$.

2. Consider the curve given by the vector function $\mathbf{r}(t) = \langle t^2, 1 - 3t, 1 + t^3 \rangle$.
   (a) Find the value(s) of $t$ for which the curve passes through the points $(1, 4, 0)$ and $(9, -8, 28)$.
   (b) Show that the curve does not pass through the point $(4, 7, -6)$.

We say that two curves $\mathbf{r}_1(t)$ and $\mathbf{r}_2(t)$ *intersect* if they ever pass through the same point and that they *collide* if they cross at the same time.

For example, the curves $\mathbf{r}_1(t) = \langle t - 1, 0 \rangle$ and $\mathbf{r}_2(t) = \langle \cos t, \sin t \rangle$ intersect at points $(-1, 0)$ and $(1, 0)$ but they do not collide. Before continuing, reflect upon why this is the case.

3. Two curves $\mathbf{r}_1(t)$ and $\mathbf{r}_2(s)$ intersect if there are $t_0$ and $s_0$ such that $\mathbf{r}_1(t_0) = \mathbf{r}_2(s_0)$. These curves collide here if ____________.

4. Suppose two missiles are fired with trajectories given by the vector functions

$$\mathbf{r}_1(t) = \langle (t-4)^2, t^2 - 8t + 34, (t-4)^2 \rangle \qquad \text{and} \qquad \mathbf{r}_2(t) = \langle 4t - 19, (t-4)^3, 5t - 26 \rangle$$

   Assuming $t \geqslant 0$, will these missiles collide? If so, when?

   *Hint:* It may be helpful to rename the variable in the second trajectory as $s$, namely $\mathbf{r}_2(s) = \langle 4s - 19, (s-4)^3, 5s - 26 \rangle$.

5. Find an equation for the line tangent to the curve $\mathbf{r}(t) = \langle e^t, te^t, te^{t^2} \rangle$ at the point $(1, 0, 0)$.