Math 281 Homework 3 Name: _____

Complete the following problems on your own paper. If you use notebook paper, please remove the jagged edges of the paper before submitting your homework. Your solutions must be numbered and submitted in the order the problems were given, legibly written using correct notation and including all mathematical details. If you submit work that is messy, disorganized, or lacking detail, you should expect to receive little credit regardless of having the correct final answer.

Due: 8:00am on Tuesday, October 22

1. Use traces to identify the surfaces. Sketch the region bounded by the surfaces and determine the curve of intersection. Find a vector function that parametrizes the curves of intersection.
   (a) $z = \sqrt{x^2 + y^2}$ and $x^2 + y^2 + z^2 = 6$ for $z \geq 0$
   (b) $z = x^2 + 3y^2$ and $z = 12 - 3x^2 - y^2$

2. Consider the vector function $\vec{r}(t) = < \sqrt{16 - t^2}, t^2 - 2t + 1, \dfrac{t+3}{t^2 - 2t - 3} >$
   (a) Find the domain of $\vec{r}(t)$
   (b) Find $\vec{r}\,'(t)$
   (c) Find the vector equation for the tangent line to curve at the point $(4, 1, -1)$.

3. In general, the magnitude of a vector function is a scalar function. We may want to know the rate at which the magnitude of the position vector, $\vec{r}\,(t)$, changes along the space curve defined by the function. Suppose $\vec{r}\,(t) \neq \vec{0}$ is a differentiable vector function. Show that

$$\frac{d}{dt}\left|\vec{r}\,(t)\right| = \frac{1}{\left|\vec{r}\,(t)\right|}\vec{r}\,(t) \cdot \vec{r}\,'\,(t)$$

   Hint : Rewrite $\left|\vec{r}\,(t)\right|^2$ using the dot product and differentiate the result.