Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

Name: _____

1. To answer the following questions use the function given in polar coordinates

$$r = 2 + 2\sin(\theta)$$

   (a) Graph.

   (b) Find the tangent line to the function at $t = \pi/3$.

2. Consider points $A(0,0,2)$, $B(-1,1,5)$, and $C(0,1,0)$.

   (a) Find the area of parallelogram ABCD and find the area of triangle ABC.

   (b) Find the standard equation of the plane containg the three points A, B, and C.

   (c) Find the parametric equation of the plane containg the three points A, B, and C.

3. Let $\mathbf{r}(t) = \langle 3t^2, t^3 \rangle$.

   (a) What is the velocity, acceleration of this particle.

   (b) Compute $\mathbf{T}(t)$.

   (c) Graph $\mathbf{v}(1)$, and $\mathbf{a}(1)$ coming out from the point $\mathbf{r}(1)$. What does this tell you?

4. Let $\mathbf{r}(t) = \langle 3\cos(t^3), 5\sin(t^3), 4\cos(t^3)\rangle$. Compute $\mathbf{v}(t)$, $\mathbf{T}(t)$, and $\mathbf{N}(t)$.

5. For the equation $z = 3x^2 + y^2$, graph the traces at $z = -1, 0, 1, 2, 3$ and at $x = 0$. Then graph the equation.

6. Compute (using many paths) $\lim_{(x,y)\to(0,0)} \dfrac{x^2 - 3xy + y^2}{x^2 + y^2}$

7. Let $f(x, y, z) = 4x^2 - e^{y^2}$. Let $\nabla = \langle \frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z} \rangle$. Compute the following.

   (a) Compute $f_x(x, y, z)$ and $f_y(x, y, z)$.

   (b) Compute
   $$\nabla f(x, y, z)$$

   (c) Compute
   $$\nabla \cdot \langle 4x^2, e^{y^2}, xz^2 \rangle.$$