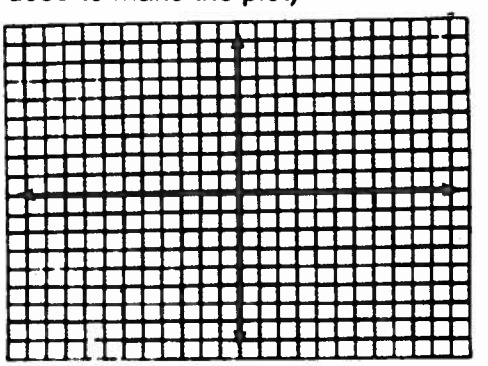
Math 2100 Major Homework 3

Use $x = 5 + 4\cos \pi t$ to answer #1-4 below.
$y = 4 + 2\sin \pi t$

1. Plot the given parametric equation. (Scale and label your axes)
2. What range of *t*-values does it take to generate the entire figure exactly once? Support your answer and write it in precise interval notation.
3. Find the equations for $\frac{dx}{dt}$, $\frac{dy}{dt}$, and $\frac{dy}{dx}$.
4. What is the name for this figure? Support your answer by converting the parametric equation to a rectangular equation (i. e. eliminate the parameter).
5. Plot the relation $\begin{cases} x(t) = 8\cos^3 t \\ y(t) = 8\sin^3 t \end{cases}$ on the graph below. This figure is called an *astroid.*

   (Show a table of values used to make the plot)



6. Now, convert the parametric equation given in problem #16 to rectangular form in order to find the rectangular equation for an astroid.
7. Suppose a bug is clinging to the edge of a wheel that is rolling along a straight and flat road.
   a. Find a parametric equation that describes the path the bug follows.
   b. Look up the integral that gives the length of a parametrically defined curve. And write the integral that that gives the distance the bug moves as the wheel rotates one time.
   c. Compute the integral in part b. (If you don't see how to do it, you can ask Mathematica, Wolfram Alpha or another software product to help.)
   d. What is the ratio of the distance the center of the wheel goes compared to the the distance the bug goes during one turn of the wheel?
8. Give a piecewise defined function whose graph looks the following. Make the function continuous and smooth with critical points as they appear in the graph.