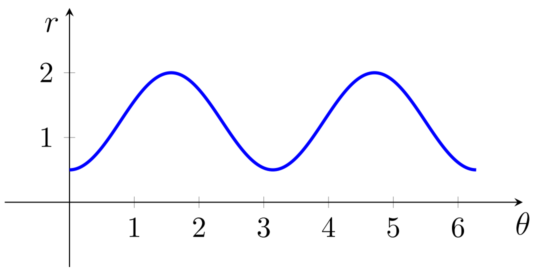
Math 242 - Homework 1 **Due Thursday, September 4**

Part 1

1. Sketch the region of the plane whose polar coordinates satisfy the given conditions.
   (a) $1 \le r \le 2, \quad \pi/4 \le \theta \le \pi$
   (b) $0 < r \le 4$
   (c) $-1 \le r \le 1, \quad \pi/4 \le 3\pi/4$

2. Sketch the curve with the given polar equation without a computer.
   (a) $r = \sin(\theta)$
   (b) $r^2\theta = 1$

3. The figure below shows the graph of r as a function of θ in rectangular coordinates. Use it to sketch the corresponding polar curve.



4. Use a computer or calculator to graph the polar curve. Choose the parameter interval to make sure you produce the entire curve.
   (a) $r = 1 + 2\sin(\theta/2)$ (nephroid of Freeth)
   (b) $r = \sqrt{1 - 0.8\sin^2\theta}$ (hippopede)

5. (a) Use a computer or calculator to investigate the family of curves defined by the polar equations $r = \sin(n\theta)$, where n is a positive integer. How is the number of loops related to n?
   (b) How is the number of loops related to n if $r = |\sin(n\theta)|$? *In Sage the absolute value function is:* `abs( )`.

6. A family of curves is given by the equations $r = 1 + c\sin\theta$, where c is a real number. What kinds of shapes are possible? How do the shapes of the curve change as c changes? Make sure you graph enough examples to support your conclusions. (These curves are called **limaçons**).

Part 2

7. Graph the polar curves $r = \cos(2\theta)$ and $r = \frac{1}{2}$. At how many points do the two curves intersect?

8. Use a computer to sketch the curve and then find the area it encloses.
   (a) $r = 2\cos(3\theta)$
   (b) $r^2 = \sin(2\theta)$, $0 \le \theta \le \pi/2$.

9. Express dy/dx as a function of θ for the curve $r = 3 + 2\sin(\theta)$