Goal: Describe points in a two dimensional plane using angles and linear distance instead of vertical and horizontal displacement.

When we want to describe a particular location in two dimensional space, we've been using Cartesian coordinates. We find a point by first picking a special point (the origin) and then measuring horizontal displacement (x-coordinate) and vertical displacement (y-coordinate).

That is often less than ideal. How do we trace circles? Spirals? Other weird curvy things? Enter polar coordinates! To locate a point using polar coordinates, pick a special point (the origin) and a special ray (usually drawn horizontally and to the right), measure the distance (r) between the origin and our point of interest and then ask what angle that makes with our special ray (θ, often measured in radians, counterclockwise is positive). Seems easy, right? Let's jump right in.

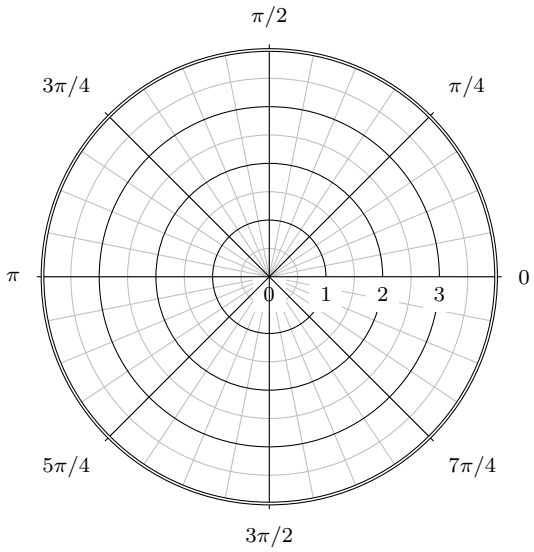
1. Plot the following points on the grid at right:

   (a) $(r, \theta) = (2, 2\pi/3)$

   (b) $(r, \theta) = (4, 3\pi/2)$

   (c) $(r, \theta) = (-3, 3\pi/4)$

   (d) $(r, \theta) = (0, 11\pi/6)$



2. We need a way to translate between polar coordinates and rectangular coordinates. Suppose the polar coordinate (r, θ) and the rectangular coordinate (x, y) correspond to the same location in the plane.

   (a) Using trigonometry, we have the formula

   $$\frac{x}{r} = \cos(\theta).$$

   Write down a similar formula corresponding to y.

(b) Solve the formulas above for x and y, respectively. Now you have a way to covert polar coordinates to rectangular coordinates!

(c) On the other hand, can you find two formulas that will help you solve for r and θ?

(d) Solve your formulas for r and θ and you'll have a way to convert rectangular coordinates to polar coordinates! (It's okay if your formula for θ depends on which quadrant the point is in.)

3. Convert $(r, \theta) = (2, 2\pi/3)$ into rectangular coordinates.

4. Convert $(x, y) = (-5, -5\sqrt{3})$ into polar coordinates.

5. Convert $r = 2$ into rectangular coordinates. What shape is this curve?

6. Convert $r = 3\cos(\theta)$ into rectangular coordinates.