Name: ───────────────────────────────────────   Section: ──────────

Names of collaborators: ───

Main Points:

1. polar coordinates, converting from Cartesian coordinates to polar and vice versa

2. sketching curves by first finding Cartesian equation of curve or by first sketching r as a function of θ

1. Polar coordinates

The xy-coordinates that we are familiar with are called Cartesian coordinates. Some curves are more easily described in terms of distance from the origin and angle with a fixed axis. Read the first few paragraphs of the section as well as Example 1 for a description of polar coordinates.

Examples 2 and 3 show how to convert back and forth from polar to Cartesian coordinates.

Exercises.

1. Plot the point whose polar coordinates are given. Then find two other pairs of polar coordinates of this point, one with $r > 0$ and one with $r < 0$.

    (a) $(2, \pi/3)$

    (b) $(1, -3\pi/4)$

2. What equations do we use to find the Cartesian coordinates of a point whose polar coordinates are known? (See the bottom of p 655.)

3. What equations do we use to find the polar coordinates if the Cartesian coordinates are known? (See the top of page 656.)

4. Plot the point whose polar coordinates are given. Then find the Cartesian coordinates of the point.

   (a) $(2, -2\pi/3)$

   (b) $(-2, 3\pi/4)$

5. The Cartesian coordinates of a point are $(-1, \sqrt{3})$.

   (a) Find polar coordinates (r, θ) of this point, where $r > 0$ and $0 \le \theta < 2\pi$.

   (b) Find polar coordinates (r, θ) of this point, where $r < 0$ and $0 \le \theta < 2\pi$.

6. Sketch the region in the plane consisting of points whose polar coordinates satisfy the given conditions:

   (a) $r \geq 1$

   (b) $1 \leq r < 2, \quad \pi \leq \theta \leq 3\pi/2.$

2. Curves in Polar Coordinates

As mentioned above, the equations for certain curves (for example circles!) are much simpler in polar coordinates than in Cartesian coordinates. See Examples 4, 5 and 6.

Exercises.
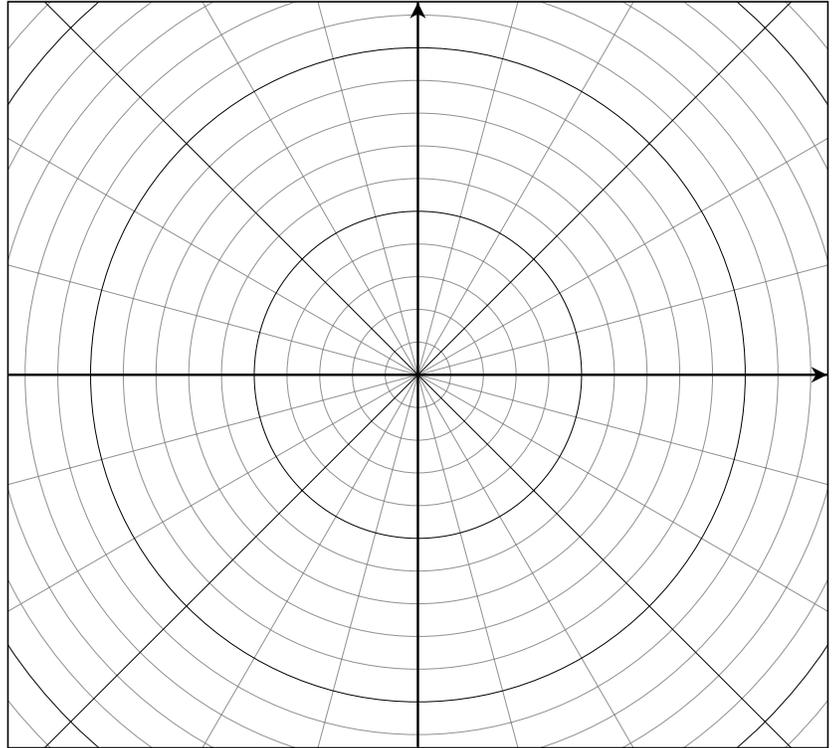
7. Sketch the polar curves.

   (a) $r = 4$

   (b) $\theta = \frac{\pi}{6}$

   (c) $r = \theta$

8. Consider the polar curve $r = \sin\theta$.

(a) Fill in the table of values, plot the points, and sketch the curve.

θ	r
0	
$\frac{\pi}{6}$	
$\frac{\pi}{4}$	
$\frac{\pi}{3}$	
$\frac{\pi}{2}$	
$\frac{2\pi}{3}$	
$\frac{3\pi}{4}$	
$\frac{5\pi}{6}$	
π	
$-\frac{\pi}{6}$	
$-\frac{\pi}{4}$	
$-\frac{\pi}{3}$	
$-\frac{\pi}{2}$	
$-\frac{2\pi}{3}$	
$-\frac{3\pi}{4}$	
$-\frac{5\pi}{6}$	

(b) Find a Cartesian equation for the curve. Do you recognize the curve that this equation describes?