Name: _____ **Section:** _____

Names of collaborators: _____

Main Points:

1. sketching polar curves (more)
2. slope of tangent

1. More Curve Sketching in Polar Coordinates

We have graphed some simple polar curves by plotting points. Now we will graph some less trivial polar curves both by hand and using *Mathematica*. Read Examples 7 and 8 (p 658), and read the paragraphs about symmetry on page 659 to gain some tips for graphing more complicated polar curves.

Exercises.

1. Consider the polar curve $r = 1 - \cos\theta$.

   (a) Sketch the graph of r as a function of θ in Cartesian coordinates. (This means put θ on a horizontal axis and r on a vertical axis. See Figure 10 in Example 7.)

   For what θ-values is r increasing? decreasing?

   (b) Use your work in (a) to sketch a rough graph of the polar curve.

   (c) Which of the listed symmetry rules (on p 659) would help graph the polar curve in this problem?

2. Consider the polar curve $r = 4\sin 3\theta$. (See Example 8.)

   (a) Sketch the graph of r as a function of θ in Cartesian coordinates. Label the increasing and decreasing parts of the curve with numbers, as in Figure 12, Example 8.

   (b) Use your work in (a) to sketch a rough graph of the polar curve.

   (c) Which of the symmetry rules would help graph the polar curve in this problem?

   (d) Use the `PolarPlot` command in *Mathematica* to check your work. Try the following:

```
PolarPlot[4 Sin[3 theta], {theta, 0, Pi/3}]
PolarPlot[4 Sin[3 theta], {theta, 0, Pi}]
PolarPlot[4 Sin[3 theta], {theta, 0, 2 Pi}]
```

   Sketch your results below.

3. Use *Mathematica* to plot the polar curves. Experiment with the θ-range to see how it affects the curve. Sketch your results.

   (a) $r = \theta \cos 5\theta$

   (b) $r = \theta^{1/8}$

   (c) $r = \sin(\theta/4)$

2. Tangents to Polar Curves

To find the slope of a tangent line, use the fact that $x = r\cos\theta$ and $y = r\sin\theta$ to rewrite the polar equation as a pair of parametric equations, and use the methods of 10.2. See Example 9.

Exercises.

4. Find the slope of the tangent line to the polar curve $r = \theta$ at the point specified by $\theta = \pi$.

5. Find the slope of the tangent line to the polar curve $r = 2\sin\theta$ at the point specified by $\theta = \pi/6$. (Hint: After finding parametric equations $x(\theta)$ and $y(\theta)$, use trig. identities before differentiating.)