# Calculus of Polar Curves (Appendix H2) 

Thanks to Faan Tone Liu

## Key Points:

- Area of a sector:


Area of entire circle $=$
Fraction of circle $=$
Area of sector $=$

- Area of a polar region:


Area of thin slice $=$
Estimate of area $=$
Exact area $=$

- To find the slopes of tangent lines to polar curves and arc length of polar curves, use parametric equations:

$$
\begin{aligned}
x & = \\
y & = \\
\frac{d y}{d x} & =
\end{aligned}
$$

Arc length $=$

Arc length $($ simplified $)=$

- Other Notes:


## Examples:

1. Find the area inside the region bounded by $r=3+3 \sin \theta$
2. Find the area of the region that lies inside both $r=1+\sin \theta$ and $r=3 \sin \theta$.
3. Find the length of $r=2 \csc \theta$ from $\theta=\frac{\pi}{6}$ to $\theta=\frac{\pi}{2}$. What is the slope of the curve at $x=\frac{\pi}{2}$ ?
4. Find the arc length of the cardioid $3+3 \sin \theta$.
