

Let C be the curve traced out by $y = \sin(x)$.

1. Find a parametrization $r(t)$ of C as a curve in \mathbb{R}^3 .
2. Calculate the curvature κ of C as a function of t by hand.
3. Find the curvature corresponding to the points $x = \frac{\pi}{4}$, $\frac{\pi}{2}$, and $\frac{5\pi}{4}$.
4. Find the unit tangent $T(t)$ and principal unit normal $N(t)$ at the same points as you did in #3.
5. At each of the three points, plot C and the circle of radius $\frac{1}{\kappa}$ centered at $r(t) + \frac{1}{\kappa}N(t)$. This is the *osculating circle*.