## Using derivatives with polar functions

**Ex. Find the equation of the tangent line to $r = 1 + \sin\theta$ when $\theta = \frac{\pi}{3}$**

Still use $y - y_1 = m(x - x_1)$

$x = r\cos\theta$

$x = (1 + \sin\theta)\cos\theta$

$x = \left(1 + \sin\frac{\pi}{3}\right)\left(\cos\left(\frac{\pi}{3}\right)\right)$

$x = \left(1 + \frac{\sqrt{3}}{2}\right)\left(\frac{1}{2}\right)$

$x = \frac{2+\sqrt{3}}{4}$

$y = r\sin\theta$

$y = (1 + \sin\theta)\sin\theta$

$y = \left(1 + \sin\frac{\pi}{3}\right)\left(\sin\left(\frac{\pi}{3}\right)\right)$

$y = \left(1 + \frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$

$y = \frac{2\sqrt{3}+3}{4}$

To find the slope of a tangent line for a polar function

$y = (1 + \sin\theta)\sin\theta \qquad x = (1 + \sin\theta)\cos\theta$

$$m = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{(1+\sin\theta)(\cos\theta)+(\cos\theta)(\sin\theta)}{(1+\sin\theta)(-\sin\theta)+(\cos\theta)(\cos\theta)}$$

for $\theta = \frac{\pi}{3}$ $\quad \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{(1+\sin\frac{\pi}{3})(\cos\frac{\pi}{3})+(\cos\frac{\pi}{3})(\sin\frac{\pi}{3})}{(1+\sin\frac{\pi}{3})(-\sin\frac{\pi}{3})+(\cos\frac{\pi}{3})(\cos\frac{\pi}{3})} = \frac{\left(1+\frac{\sqrt{3}}{2}\right)\left(\frac{1}{2}\right)+\left(\frac{1}{2}\right)\left(\frac{\sqrt{3}}{2}\right)}{\left(1+\frac{\sqrt{3}}{2}\right)\left(-\frac{\sqrt{3}}{2}\right)+\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)}$

$$= \frac{\frac{2+2\sqrt{3}}{4}}{\frac{-2\sqrt{3}-2}{4}} = \frac{2+2\sqrt{3}}{-2\sqrt{3}-2} = -1$$

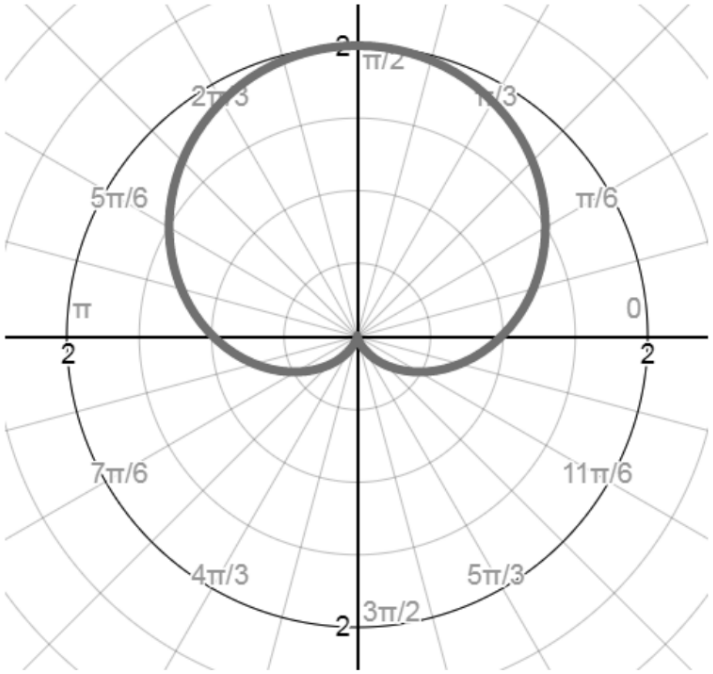
Equation of line tangent to $r = 1 + \sin\theta$ when $\theta = \frac{\pi}{3}$

$$y - \frac{2\sqrt{3}+3}{4} = -\left(x - \frac{2+\sqrt{3}}{4}\right)$$

**r = 1 + sin θ**

$$y - \frac{2\sqrt{3}+3}{4} = -\left(x - \frac{2+\sqrt{3}}{4}\right)$$

$$y - 1.616 = -(x - 0.933)$$




$$y - \frac{2\sqrt{3}+3}{4} = -\left(x - \frac{2+\sqrt{3}}{4}\right)$$

Consider the polar curve $r = \sin^2(2\theta)$.

What is the equation of the tangent line to the curve $r$ at $\theta = \frac{\pi}{4}$?

Choose 1 answer:

(A) $y - \frac{\sqrt{2}}{2} = -\left(x - \frac{\sqrt{2}}{2}\right)$

(B) $y - 1 = -\left(x - \frac{\pi}{4}\right)$

(C) $y + 1 = -\frac{\sqrt{2}}{2}\left(x - \frac{\pi}{4}\right)$

(D) $y - \frac{\sqrt{2}}{2} = -\frac{\sqrt{2}}{2}\left(x - \frac{\sqrt{2}}{2}\right)$