POLAR CALCULUS

Method. The curve $r = f(\theta)$ can be parameterized as $\boxed{x = f(\theta)\cos\theta,\ y = f(\theta)\sin\theta}$. Then $\boxed{\dfrac{dy}{dx} = \dfrac{dy/d\theta}{dx/d\theta}}$.

The arc length of the curve is given by $\boxed{L = \displaystyle\int_\alpha^\beta \sqrt{[f(\theta)]^2 + [f'(\theta)]^2}\, d\theta}$. The area inside the curve is $\boxed{A = \displaystyle\int_\alpha^\beta \frac{1}{2}[f(\theta)]^2\, d\theta}$.

1. Find an equation for the tangent line to the cardioid $r = 1 + \cos\theta$ when $\theta = \frac{\pi}{3}$.

2. Calculate the arc length of the cardioid $r = 1 + \cos\theta$.

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3. Find the area outside $r = 1 + \cos\theta$ and inside $r = 3\cos\theta$ (link to Desmos).

4. Find equations for the tangent lines to the cardioid $r = 1 + 2\cos\theta$ at $\theta = \frac{2\pi}{3}$ and at $\theta = \frac{4\pi}{3}$. Plot the cardioid and both lines (link to Desmos). What's up with that?