POLAR

Find $\frac{dy}{dx}$

1. $r = \frac{1}{\theta}$

2. $r = 2\cos 2\theta$

Find the slope of the tangent line to the given polar curve at the point specified by the value of θ.

3. $r = 2 - \sin\theta, \quad \theta = \frac{\pi}{3}$

4. $r = \cos\left(\frac{\theta}{3}\right), \quad \theta = \pi$

5. $r = 1 + 2\cos\theta, \quad \theta = \frac{\pi}{3}$

POLAR

Find $\frac{dy}{dx}$

1. $r = \frac{1}{\theta}$

$x = \frac{1}{\theta}\cos\theta \qquad y = \frac{1}{\theta}\sin\theta$

$$\frac{dy}{dx} = \frac{\frac{1}{\theta}\cdot\cos\theta + \sin\theta\cdot\frac{-1}{\theta^2}}{\frac{1}{\theta}\cdot-\sin\theta + \cos\theta\cdot\frac{-1}{\theta^2}}$$

2. $r = 2\cos 2\theta$

$x = 2\cos 2\theta\cos\theta \qquad y = 2\cos 2\theta\sin\theta$

$$\frac{dy}{dx} = \frac{2\cos 2\theta\cdot\cos\theta + \sin\theta\cdot 2\cdot -\sin 2\theta\cdot 2}{2\cos 2\theta\cdot-\sin\theta + \cos\theta\cdot 2\cdot -\sin 2\theta\cdot 2}$$

Find the slope of the tangent line to the given polar curve at the point specified by the value of θ.

3. $r = 2-\sin\theta, \quad \theta = \frac{\pi}{3}$

$x = (2-\sin\theta)\cos\theta \qquad y = (2-\sin\theta)\sin\theta$

$$\frac{dy}{dx} = \frac{(2-\sin\theta)\cos\theta + \sin\theta(-\cos\theta)}{(2-\sin\theta)\cdot-\sin\theta + \cos\theta(-\cos\theta)}$$

$$\left.\frac{dy}{dx}\right|_{\theta=\pi/3} = \frac{(2-\sin\pi/3)\cos\pi/3 + \sin\pi/3(-\cos\pi/3)}{(2-\sin\pi/3)\cdot-\sin\pi/3 + \cos\pi/3(-\cos\pi/3)}$$

$$= \frac{(2-\sqrt{3}/2)(1/2) + (\sqrt{3}/2)(-\frac{1}{2})}{(2-\sqrt{3}/2)(-\sqrt{3}/2) + (1/2)(-1/2)}$$

4. $r = \cos\left(\frac{\theta}{3}\right), \quad \theta = \pi$

$x = \cos(\theta/3)\cos\theta \qquad y = \cos(\theta/3)\sin\theta$

$$\frac{dy}{dx} = \frac{\cos(\theta/3)\cos\theta + \sin\theta\cdot-\sin(\theta/3)\cdot 1/3}{\cos(\theta/3)\cdot-\sin\theta + \cos\theta\cdot-\sin(\theta/3)\cdot 1/3}$$

$$\left.\frac{dy}{dx}\right|_{\theta=\pi} = \frac{\cos\pi/3\cdot\cos\pi + \sin\pi\cdot-\sin\pi/3\cdot\frac{1}{3}}{\cos\pi/3\cdot-\sin\pi + \cos\pi\cdot-\sin\pi/3\cdot\frac{1}{3}}$$

$$= \frac{\frac{1}{2}\cdot-1 + 0\cdot}{\frac{1}{2}\cdot 0 + -1\cdot-\frac{\sqrt{3}}{2}\cdot\frac{1}{3}} = \boxed{-\sqrt{3}}$$

5. $r = 1+2\cos\theta, \quad \theta = \frac{\pi}{3}$

$x = (1+2\cos\theta)\cos\theta \qquad y = (1+2\cos\theta)\sin\theta$

$$\frac{dy}{dx} = \frac{(1+2\cos\theta)\cos\theta + \sin\theta(-2\sin\theta)}{(1+2\cos\theta)\cdot-\sin\theta + \cos\theta(-2\sin\theta)}$$

$$\left.\frac{dy}{dx}\right|_{\theta=\pi/3} = \frac{(1+2\cos\pi/3)\cos\pi/3 + \sin\pi/3(-2\sin\pi/3)}{(1+2\cos\pi/3)\cdot-\sin\pi/3 + \cos\pi/3(-2\sin\pi/3)} = \boxed{\frac{\sqrt{3}}{9}}$$