#1 a) $6\sin 3\theta = 3$ $\quad 0 \le \theta < \frac{\pi}{2}$

$\sin 3\theta = \frac{1}{2}$ $\quad 0 \le 3\theta < \frac{3\pi}{2}$

$3\theta = \sin^{-1}\left(\frac{1}{2}\right)$

$3\theta = \frac{\pi}{6}, \frac{5\pi}{6}$

$\theta = \frac{\pi}{18}, \frac{5\pi}{18}$ $\quad \left(3, \frac{\pi}{18}\right)$ and $\left(3, \frac{5\pi}{18}\right)$

b) polar $\Rightarrow$ rect

$x = r\cos\theta$ $\quad 3\cos\frac{\pi}{18}$ $\quad 3\cos\frac{5\pi}{18}$

$y = r\sin\theta$ $\quad 3\sin\frac{\pi}{18}$ $\quad 3\sin\frac{5\pi}{18}$

$(2.954, .521)$ $\quad (1.928, 2.298)$

c) $\frac{dr_1}{d\theta} = 6\cdot\cos 3\theta \cdot 3\Big|_{\theta=\frac{\pi}{4}} = 18\cos\frac{3\pi}{4} = 18\left(-\frac{\sqrt{2}}{2}\right)$

$= -9\sqrt{2}$

-12.728

when r_1 is traced, at $\theta = \pi/4$ the distance from the pole is decreasing at a rate of 12.728 units per radian

d) $x = r\cos\theta = (6\sin 3\theta)(\cos\theta) = 4$

$\theta = .253$ $\quad \theta = .696$

$r = 6\cdot\sin 3\theta$ $\quad r = 5.213$

$r = 4.132$

$(4.132, .253)$ $\quad (5.213, .696)$

e) $\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{(6\sin 3\theta)\cdot(\cos\theta) + (\sin\theta)\cdot(6\cos 3\theta)\cdot(3)}{(6\sin 3\theta)\cdot(-\sin\theta) + (\cos\theta)\cdot(6\cos 3\theta)(3)}$

$x = 6\sin 3\theta \cdot \cos\theta$

$y = 6\sin 3\theta \cdot \sin\theta$

f) $\text{slope} = \left.\frac{dy}{dx}\right|_{\theta=\pi/4} = \frac{-6}{-12} = \frac{1}{2}$

point $\left.(6\sin 3\theta\cdot\cos\theta,\ 6\sin 3\theta\cdot\sin\theta)\right|_{\theta=\pi/4} = (3,3)$

$y - 3 = \frac{1}{2}(x-3)$

#3 a) $4 + 3\cos\theta = 2\theta$

$\theta = 1.743$

$r = 3.486$ $\quad (3.486,\ 1.743)$

b) $r(\theta) = 4 + 3\cos\theta - 2\theta$

c) $\frac{dr}{d\theta} = -3\sin\theta - 2\Big|_{\theta=\pi/3} = -3\sin\pi/3 - 2$

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

the distance between the curves is decreasing at a rate of $\frac{3\sqrt{3}}{2} + 2$ units per radian when $\theta = \pi/3$

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

$x = 2\theta \cdot \cos\theta$

$y = 2\theta \sin\theta$

e) $2\theta\cos\theta + 2\sin\theta = 0$

$\theta = 2.029$

$(\overset{x}{2\theta\cos\theta}, \overset{y}{2\theta\sin\theta})$

$(-1.794, 3.639)$