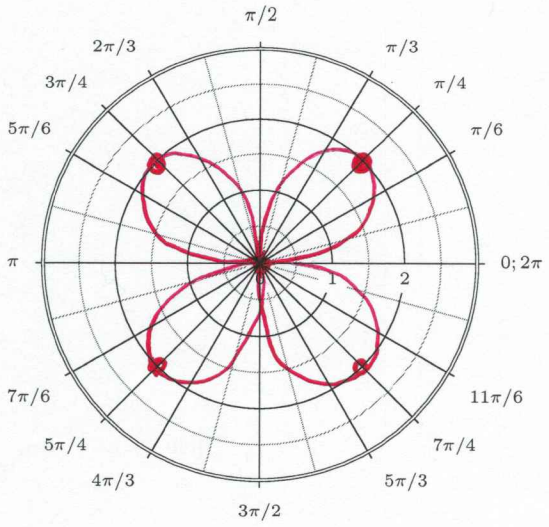
KEY

11. (a) Sketch the curve $r(\theta) = 2\sin 2\theta$. **Hint:** It should be a rose with some number of petals.



$\frac{1}{2}\int_0^{\frac{\pi}{2}} (2\sin(2\theta))^2 \, d\theta$

$\| $

$\frac{\pi}{2}$.

(b) Find the equation of the line tangent to $r(\theta)$ at the point $(\sqrt{3}, \pi/3)$.

SKIP EQUATION! Slope $= \left.\frac{4\cos(2\theta)\sin\theta + 2\cos\theta\sin(2\theta)}{4\cos\theta\cos(2\theta) - 2\sin\theta\sin(2\theta)}\right|_{\theta=\frac{\pi}{3}} = \frac{\sqrt{3}}{5}$

(c) Find the points where the tangent line to the curve $r(\theta)$ are horizontal and/or vertical.

Horiz $\Rightarrow$ numerator [(b)] $= 0$; vert $\Rightarrow$ denominator [(b)] $= 0$.

DON'T SOLVE! IT'S HARD!

(d) Find the area bounded by the any one petal of the given curve.

$\frac{\pi}{2}$

(e) Write the integral corresponding to the (arc) length of the portion of the graph of $r(\theta)$ consisting of any *two* petals.

$\int_0^{\pi} \sqrt{(2\sin 2\theta)^2 + (4\cos 2\theta)^2} \, d\theta$