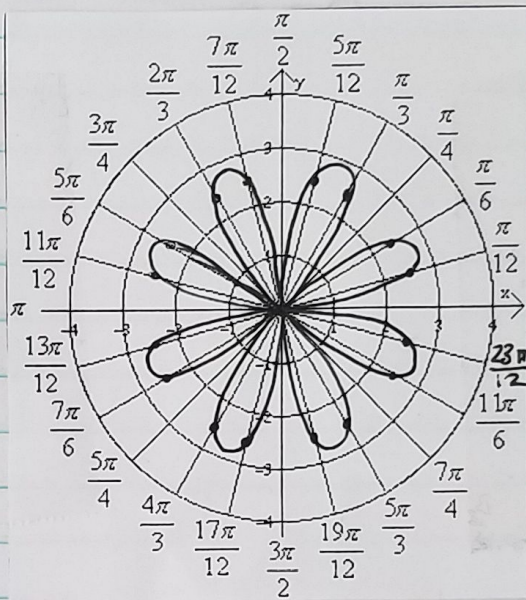


Ex #4 Analyze & graph $r = 3 \sin 4\theta$

θ	r
0	0
$\pi/12$	2.6
$\pi/6$	2.6
$\pi/4$	0
$\pi/3$	-2.6
$5\pi/12$	-2.6
$\pi/2$	0
$7\pi/12$	2.6
$2\pi/3$	2.6
$3\pi/4$	0
$5\pi/6$	-2.6
$11\pi/12$	-2.6
π	0
$13\pi/12$	2.6
$7\pi/6$	2.6
$5\pi/4$	0
$4\pi/3$	-2.6
$17\pi/12$	-2.6
$3\pi/2$	0
$19\pi/12$	2.6
$5\pi/3$	2.6
2π	0
$11\pi/6$	-2.6
$23\pi/12$	-2.6



$D: [0, 2\pi)$ $R: [-3, 3]$
 $\min r: -3$ $\max r: 3$

Symmetry: origin, x & y-axis petals: 8

"LEE-ma-son" Limaçon Curves $[r = a \pm b \sin \theta \text{ \& } r = a \pm b \cos \theta]$

$D: \mathbb{R}$

$R: [a-b, a+b]$

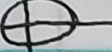
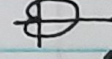
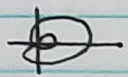
Symmetry: $\begin{cases} \sin \theta: y\text{-axis} \\ \cos \theta: x\text{-axis} \end{cases}$

inner loop: $\frac{a}{b} < 1$

cardioid: $\frac{a}{b} = 1$

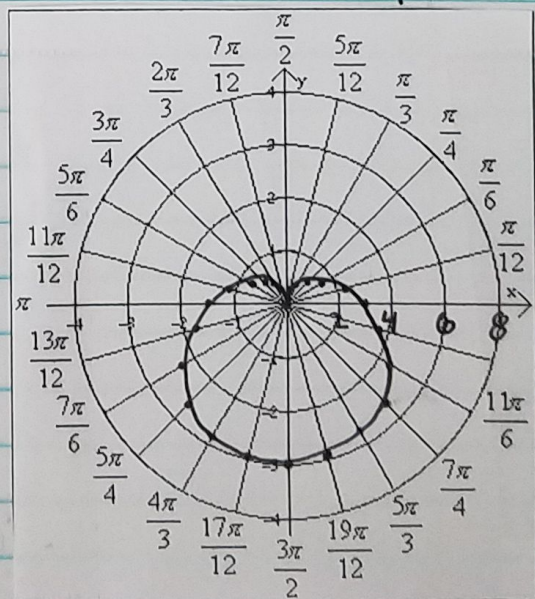
dimpled: $1 < \frac{a}{b} < 2$

convex: $\frac{a}{b} \geq 2$



Ex #5 Graph $r = 3 - 3 \sin \theta$

θ	r	θ	r
0	3	$13\pi/12$	3.8
$\pi/12$	2.2	$7\pi/6$	4.5
$\pi/6$	1.5	$5\pi/4$	5.1
$\pi/4$	.9	$4\pi/3$	5.6
$\pi/3$	.4	$17\pi/12$	5.9
$5\pi/12$	.1	$3\pi/2$	6.0
$\pi/2$	0	$19\pi/12$	5.9
$7\pi/12$	.1	$5\pi/3$	5.6
$2\pi/3$	.4	$7\pi/4$	5.1
$3\pi/4$	.9	$11\pi/6$	4.5
$5\pi/6$	1.5	$23\pi/12$	3.8
$11\pi/12$	2.2	2π	3
π	3		



6.5 Polar Graphs

Symmetry

About the

x-axis

y-axis

origin

Replace (r, θ) w/

$(r, -\theta)$ or $(-r, \pi - \theta)$

$(-r, -\theta)$ or $(r, \pi - \theta)$

$(-r, \theta)$ or $(r, \pi + \theta)$

Ex #1 Prove $r = 4 \sin 3\theta$ is symmetric about the y-axis.

$$(-r, -\theta)$$

$$-r = 4 \sin(-3\theta)$$

$$-r = -4 \sin 3\theta$$

$$r = 4 \sin 3\theta \quad \square$$

Ex #2 Prove $r = 5 \cos 2\theta$ is symmetric about the y-axis.

$$(-r, -\theta)$$

$$-r = 5 \cos(2\theta)$$

$$-r = 5 \cos 2\theta$$

OH NO! :(

$$(r, \pi - \theta)$$

$$r = 5 \cos(2(\pi - \theta))$$

$$r = 5 \cos(2\pi - 2\theta)$$

$$r = 5(\cos 2\pi \cos 2\theta + \sin 2\pi \sin 2\theta)$$

$$r = 5(1 \cos 2\theta + 0 \sin 2\theta)$$

$$r = 5 \cos 2\theta \quad \square$$

Minimizing & Maximizing r-values

Can either analyze the function or the graph.

Ex #3 What is the min & max r-values for $r = 2 + 2 \cos \theta$?

range of $\cos \theta$ is $[-1, 1]$

minimum r-value is 0 (b/c $2 + 2(-1) = 0$)

maximum r-value is 4 (b/c $2 + 2(1) = 4$)

Rose Curves $[r = a \cos n\theta \text{ \& } r = a \sin n\theta, n > 1]$

D: \mathbb{R}

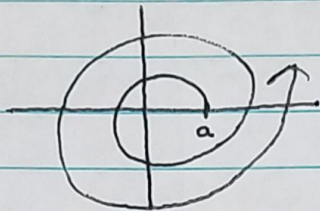
R: $[-|a|, |a|]$

of petals: $\begin{cases} n \text{ odd: } n \\ n \text{ even: } 2n \end{cases}$

symmetry: $\begin{cases} n \text{ even: origin, y-axis, x-axis} \\ n \text{ odd \& } \cos: \text{ x-axis} \\ n \text{ odd \& } \sin: \text{ y-axis} \end{cases}$

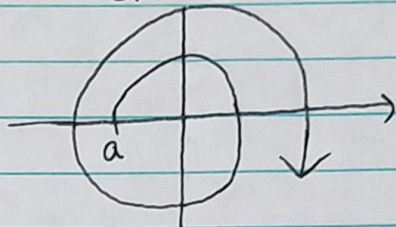
Spiral of Archimedes

$$a > 0$$



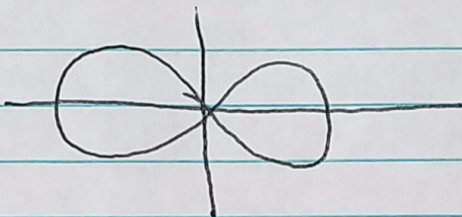
$$[r = a\theta]$$

$$a < 0$$



Lemniscate Curves

$$r^2 = a^2 \cos 2\theta$$



$$r^2 = a^2 \sin 2\theta$$

