

There are 4 types of polar graphs:

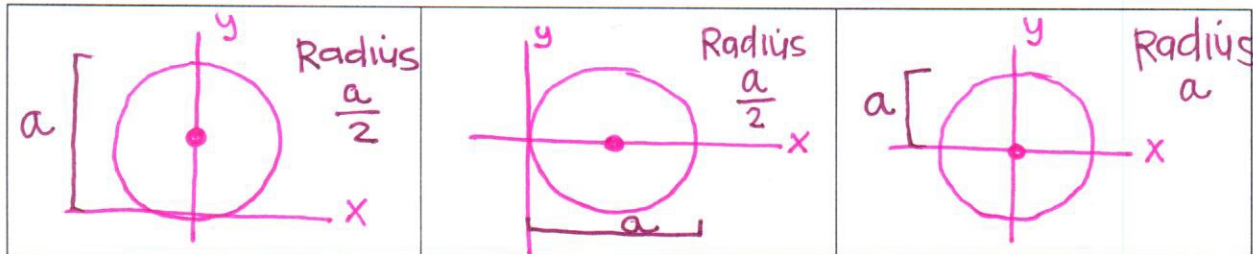
1. Circles

Equations:

$r = a \sin \theta$

$r = a \cos \theta$

$r = a$



How are circles with $r = a \sin \theta$ different from circles with $r = a \cos \theta$?

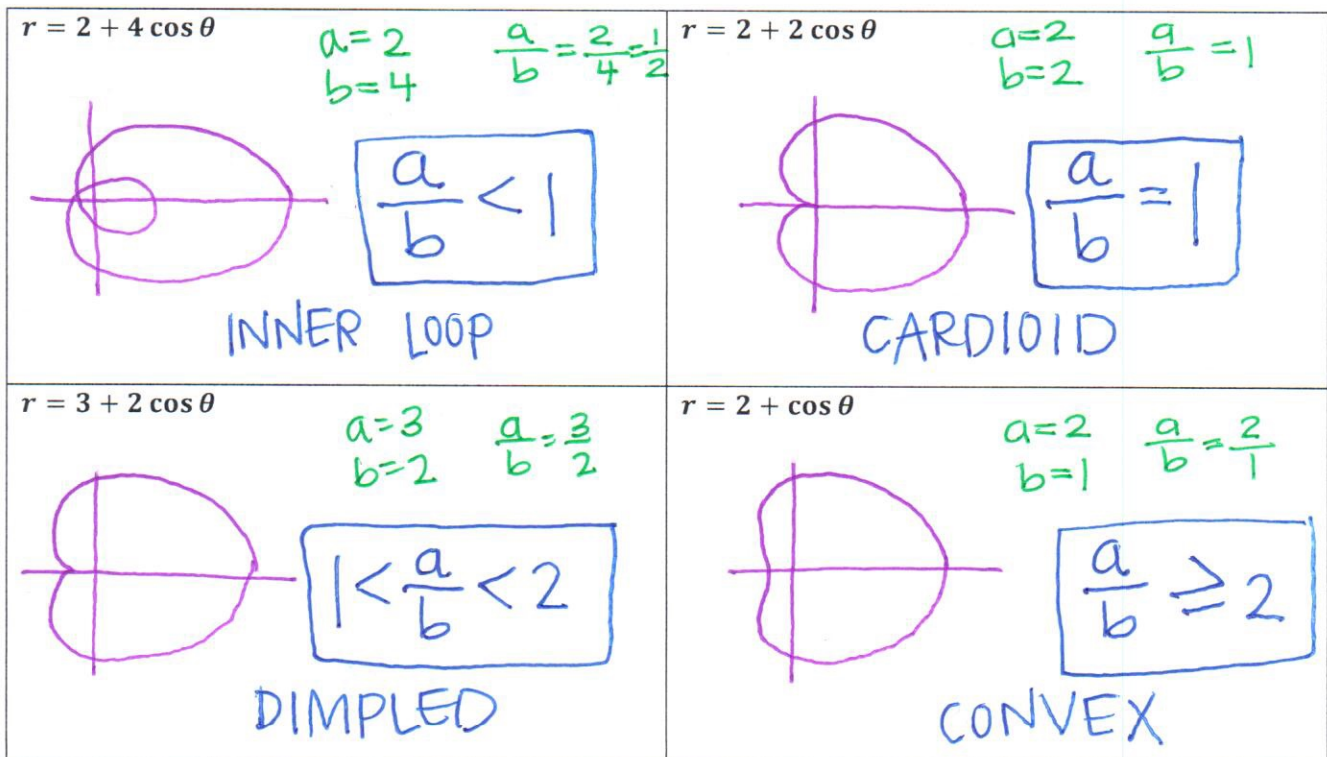
axes
centers are on different axes.

2. Limaçon Curves

There are four types of Limaçon curves. Although the general equation is the same, what changes the shape of the Limaçon is the relationship between a and b , specifically $\frac{a}{b}$. Sketch the graphs of each equation below. Then determine how a and b are related in each type of equation. Use the window $[-2, 10]$ by $[-5, 5]$

Equations: $r = a \pm b \cos \theta$

$r = a \pm b \sin \theta$



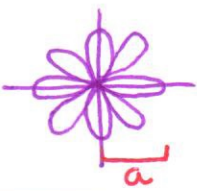


Step
 $\pi/32$

$\frac{a}{b}$

3. Rose Curves

Equations: $r = a \sin n\theta$ or $r = a \cos n\theta$


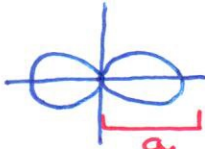
The shape of the rose curve depends on the value of n .

n is even	n is odd	n is odd
<p>either equation</p> <ul style="list-style-type: none"> • $2n$ petals • symm. to y-axis, x-axis, AND origin <p>$r = 2 \cos 4\theta$ $n=4$ 8 petals</p> <p>$a=2$ length of each petal.</p> 	<p>$r = a \cos n\theta$</p> <ul style="list-style-type: none"> • n petals • symm. to x-axis <p>$r = 2 \cos 3\theta$ $n=3$ 3 petals</p> <p>$a=2$</p> 	<p>$r = a \sin n\theta$</p> <ul style="list-style-type: none"> • n petals • symm. to y-axis <p>$r = 2 \sin 5\theta$ $n=5$ 5 petals</p> <p>$a=2$</p> 

4. Lemniscates

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

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

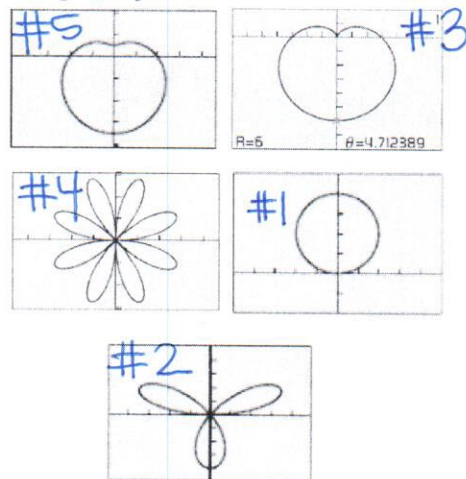
<p>$r^2 = 4 \sin 2\theta \rightarrow r = \sqrt{4 \sin 2\theta}$</p> <p>$a=2$ $n=2$</p> <p>$n = \#$ of petals $a = \text{length}$</p> 	<p>$r^2 = 16 \cos 2\theta \rightarrow r = \sqrt{16 \cos 2\theta}$</p> <p>$a=4$ $n=2$</p> 
---	--

How are circles with $r^2 = a^2 \sin 2\theta$ different from circles with $r^2 = a^2 \cos 2\theta$?

axis of symmetry

Without using your calculator, match the polar equation with its graph. Explain your choice.

- $r = 4 \sin \theta$
equation of circle, diameter=4
- $r = 4 \sin 3\theta$
 $n=3$ 3 petals symm. to y-axis
- $r = 3 - 3 \sin \theta$
limaçon $\frac{a}{b}=1$ cardioid.
- $r = 3 \sin 4\theta$
 $n=4$ 8 petals
- $r = 2 - 1.5 \sin \theta$
limaçon $\frac{a}{b} = \frac{2}{1.5} < 2$



What will $r = 3 \cos 2\theta$ look like?

Rose curve.
4 petals.
3 long.
symm. to y-axis, x-axis, origin.