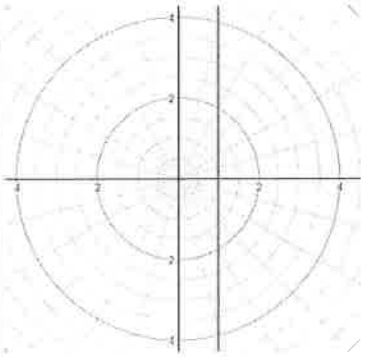
# Polar Equations of Lines

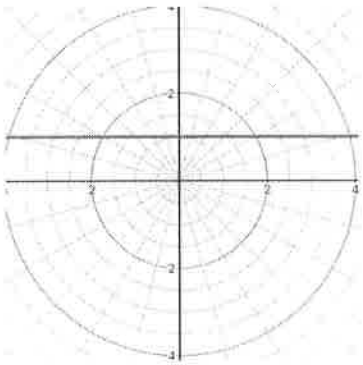
Vertical Line

$$r\cos(\theta) = a$$



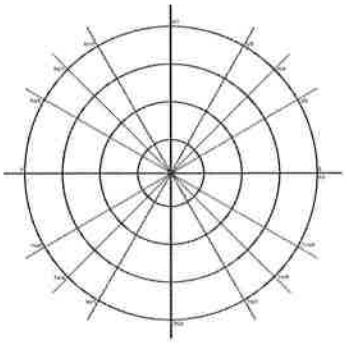
Horizontal Line

$$r\sin(\theta) = b$$



Sloped Line

$$\theta = \beta$$

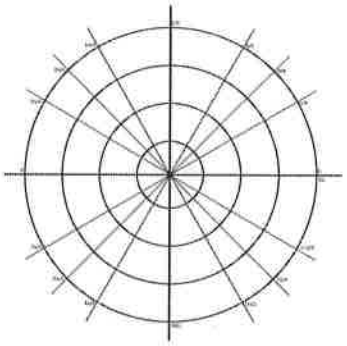


Jun 6-7:56 AM

# Polar Equations of Lines

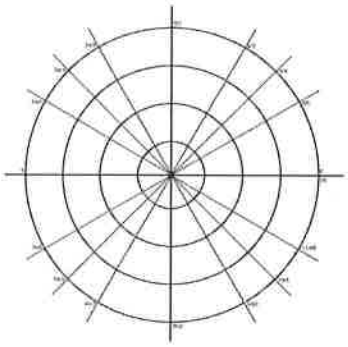
Vertical Line

$r\cos(\theta) = 2$



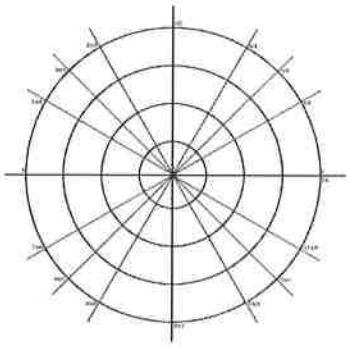
Horizontal Line

$r\sin(\theta) = -1$



Sloped Line

$\theta = \frac{\pi}{4}$

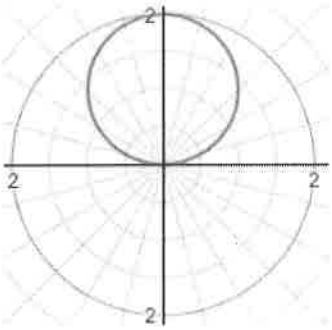


Jun 6-7:56 AM

# Polar Equations of Circles

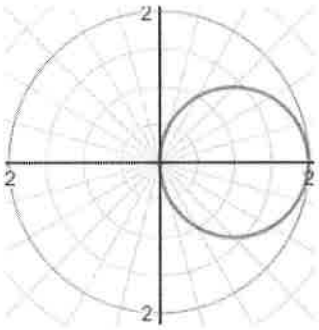
Vertical Circle

$$r = 2b\sin(\theta)$$

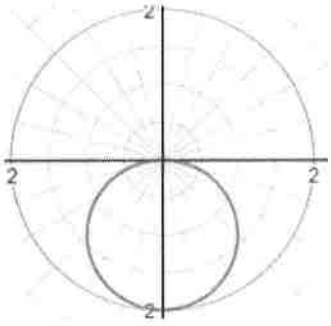



Horizontal Circle

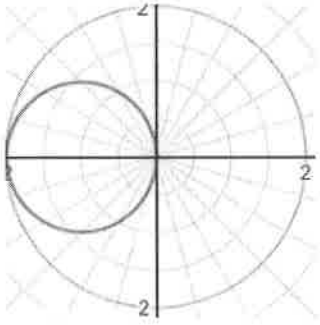
$$r = 2a\cos(\theta)$$




$$r = -2b\sin(\theta)$$

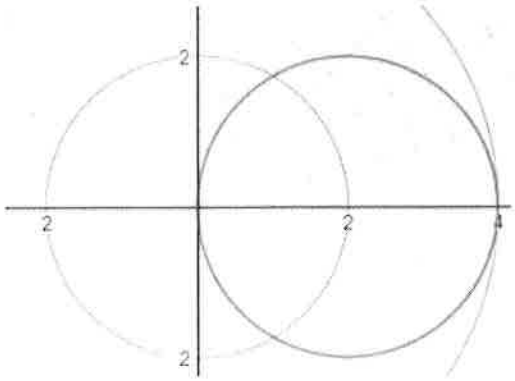



$$r = -2a\cos(\theta)$$




Circle Away from the Pole

$$r = 2a\cos(\theta) + 2b\sin(\theta)$$

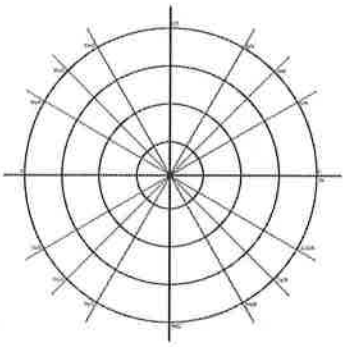



Jun 6-7:56 AM

# Polar Equations of Circles

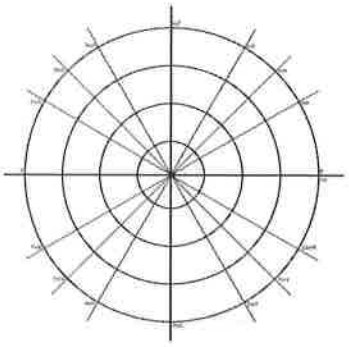
Vertical Circle

$r = 4\sin(\theta)$

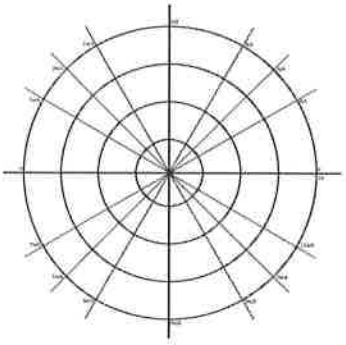


Horizontal Circle

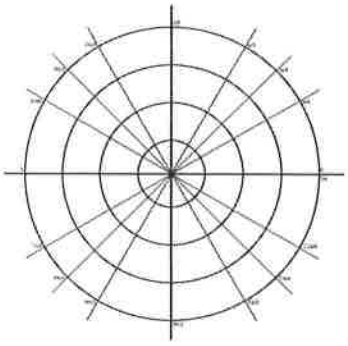
$r = 2\cos(\theta)$



$r = -6\sin(\theta)$

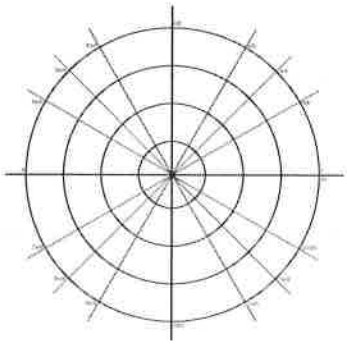


$r = -8\cos(\theta)$



Circle Away from the Pole

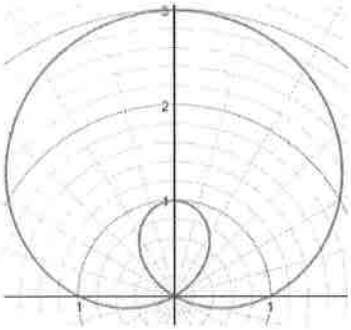
$r = 4\cos(\theta) + 2\sin(\theta)$



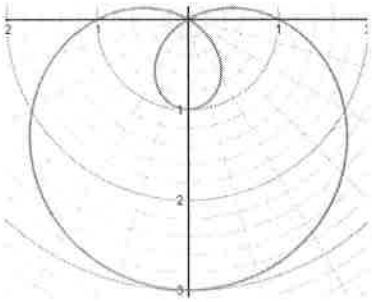
Jun 6-7:56 AM

# Limacons - Inner Loop

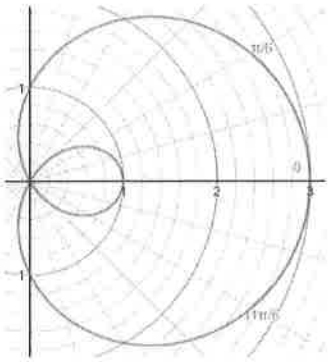
$r = a + b\sin(\theta)$ $r = a - b\sin(\theta)$



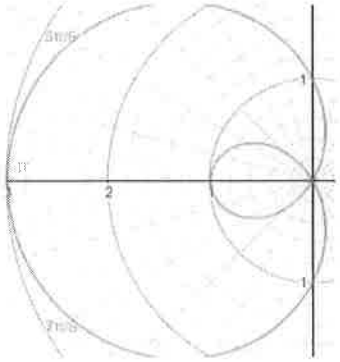
$\frac{a}{b} < 1$



$r = a + b\cos(\theta)$ $r = a - b\cos(\theta)$



$\frac{a}{b} < 1$



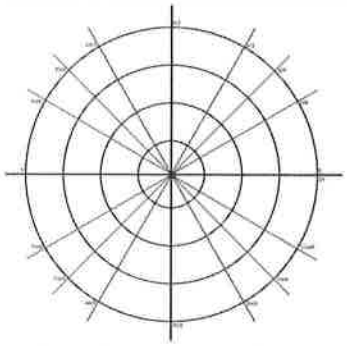
Quick Tips for Graphing Limacons

- $||a|-|b||$ distance for inner loop
- $|a|+|b|$ distance for outer loop
- a is x or y intercepts depending on orientation
- Choose four cardinal points and all multiples of $\frac{\pi}{6}$ for graphing sine equations
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

# Limacons - Inner Loop

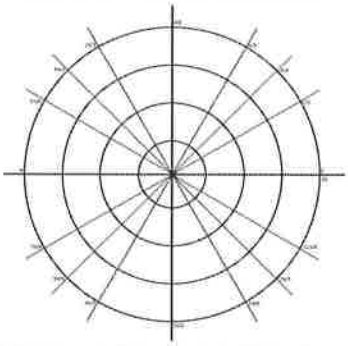
$r = 1 + 2\sin(\theta)$



| $0$ | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

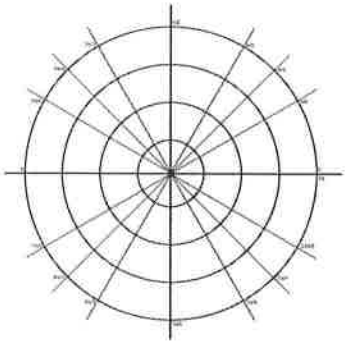
$\frac{a}{b} < 1$

$r = 2 - 3\sin(\theta)$



| $0$ | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

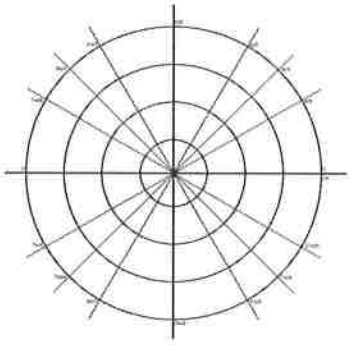
$r = 1 + 3\cos(\theta)$



| $0$ | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

$\frac{a}{b} < 1$

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



| $0$ | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

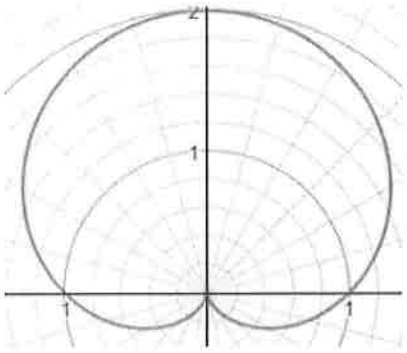
Quick Tips for Graphing Limacons

- $||a|-|b||$ distance for inner loop
- $|a|+|b|$ distance for outer loop
- a is x or y intercepts depending on orientation
- Choose four cardinal points and all multiples of $\frac{\pi}{6}$ for graphing sine equations
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

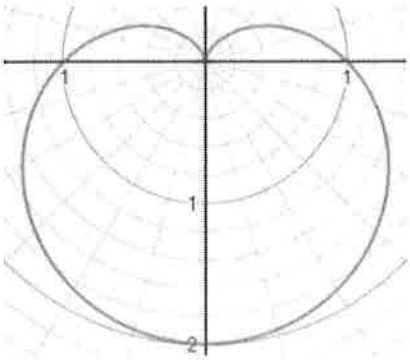
# Cardioids

$r = a + b\sin(\theta)$

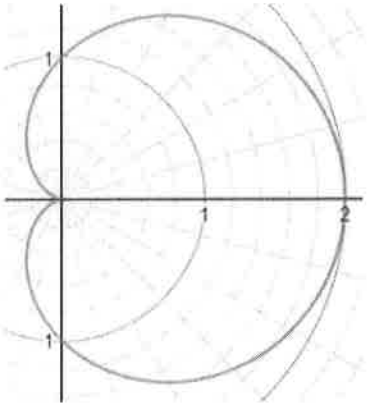


$\frac{a}{b} = 1$

$r = a - b\sin(\theta)$

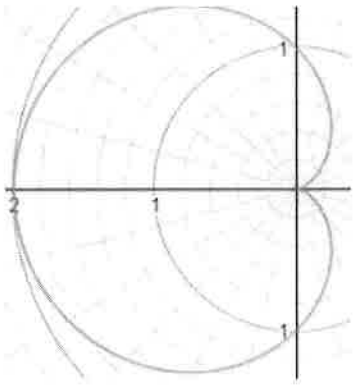


$r = a + b\cos(\theta)$



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

$r = a - b\cos(\theta)$



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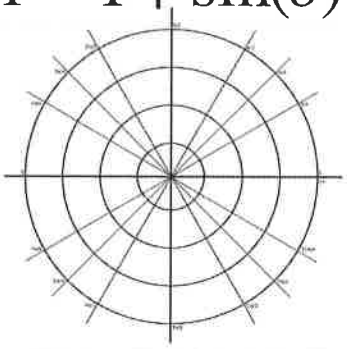
Jun 14-8:06 PM

# Cardioids

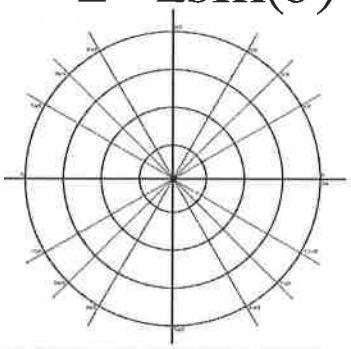
$r = 1 + \sin(\theta)$



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

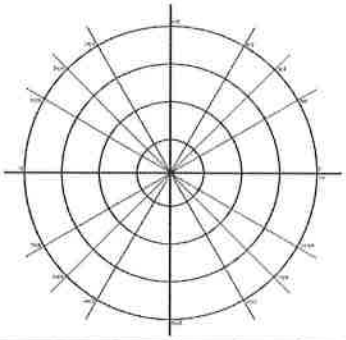
| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

$r = 2 - 2\sin(\theta)$



| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

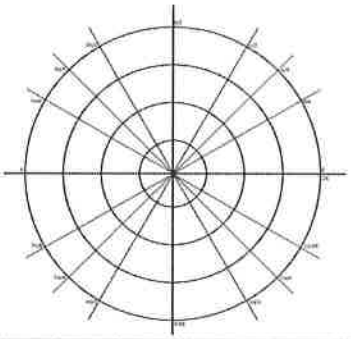
$r = \frac{1}{2} + \frac{1}{2}\cos(\theta)$



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

| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

$r = 3 - 3\cos(\theta)$



| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Quick Tips for Graphing Limacons

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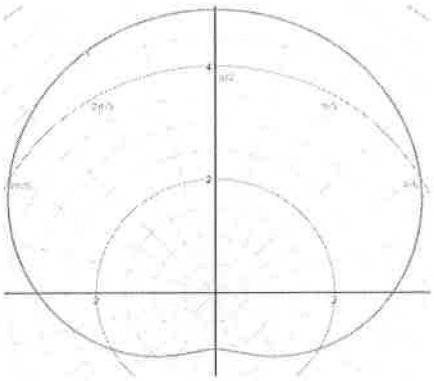
Jun 14-8:06 PM

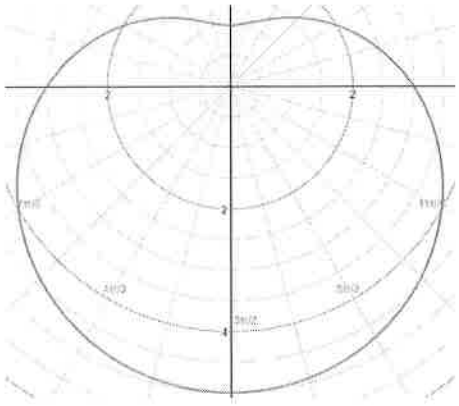
# Limacons - Dimpled

$r = a + b\sin(\theta)$

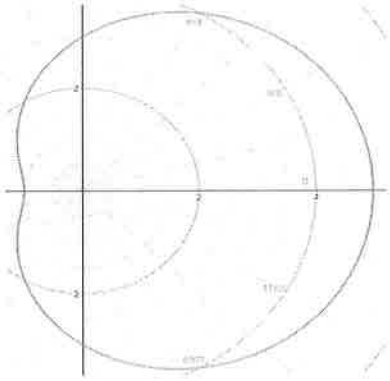


$1 < \frac{a}{b} < 2$

$r = a - b\sin(\theta)$

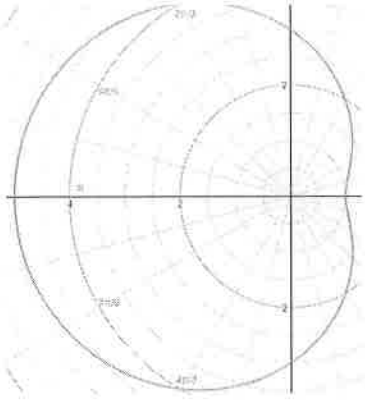


$r = a + b\cos(\theta)$



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

$r = a - b\cos(\theta)$



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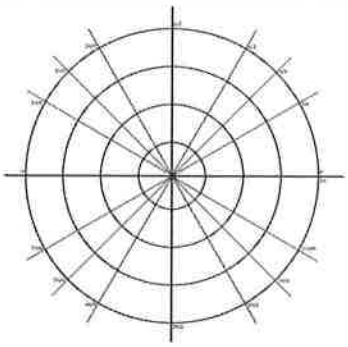
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

# Limacons - Dimpled

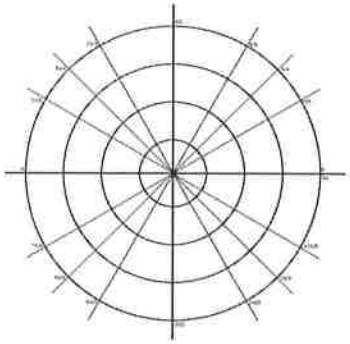
$r = 3 + 2\sin(\theta)$



| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

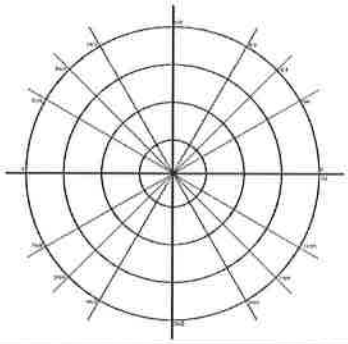
$1 < \frac{a}{b} < 2$

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



| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

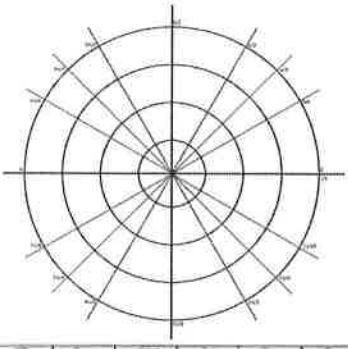
$r = 4 + 3\cos(\theta)$



| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

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

$r = 3 - 2\cos(\theta)$



| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Quick Tips for Graphing Limacons

- $||a|-|b||$ distance for inner loop
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- a is x or y intercepts depending on orientation
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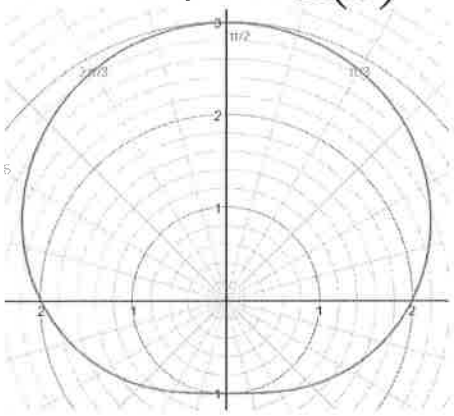
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

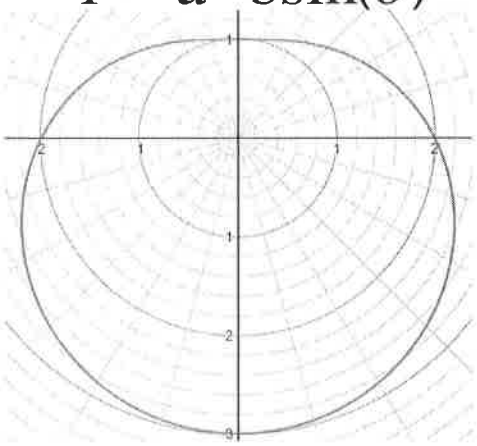
# Limacons - Convex

$r = a + b\sin(\theta)$

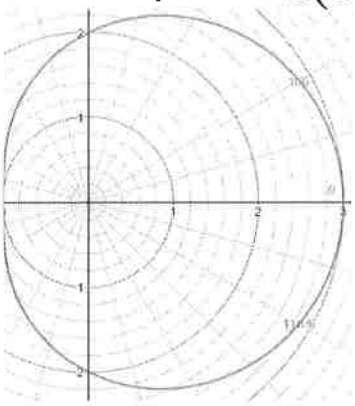


$\frac{a}{b} \geq 2$

$r = a - b\sin(\theta)$

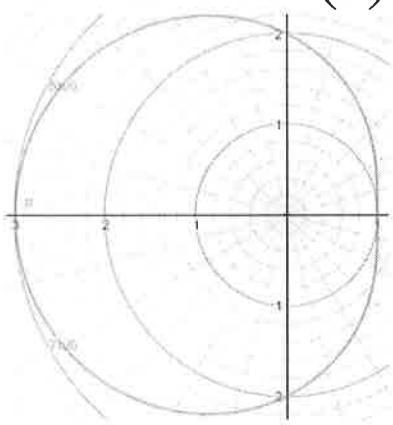


$r = a + b\cos(\theta)$



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

$r = a - b\cos(\theta)$



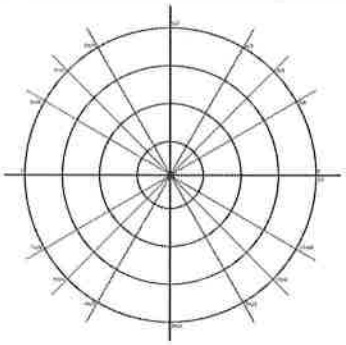
Quick Tips for Graphing Limacons

- $||a|-|b||$ distance for inner loop
- $|a|+|b|$ distance for outer loop
- a is x or y intercepts depending on orientation
- Choose four cardinal points and all multiples of $\frac{\pi}{6}$ for graphing sine equations
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

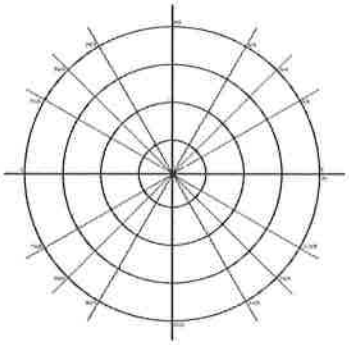
# Limacons - Convex

$r = 2 + \sin(\theta)$



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

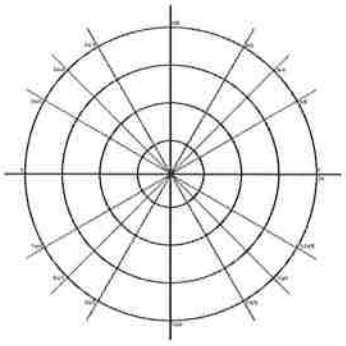
$r = 4 - 2\sin(\theta)$



| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

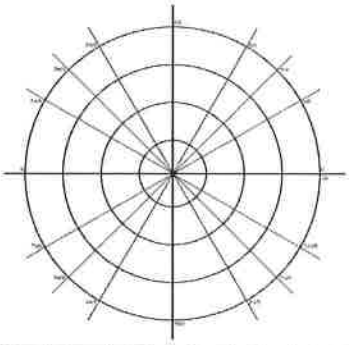
| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{3\pi}{2}$ | $\frac{11\pi}{6}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

$r = 3 + \cos(\theta)$



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

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



| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| 0 | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Quick Tips for Graphing Limacons

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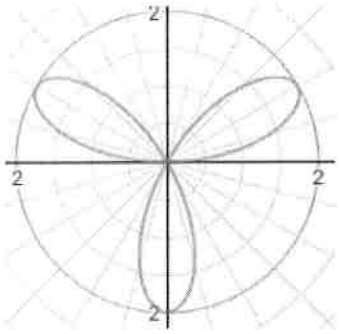
- Choose four cardinal points and all multiples of $\frac{\pi}{6}$ for graphing sine equations
- Choose four cardinal points and all multiples of $\frac{\pi}{3}$ for graphing cos functions

Jun 14-8:06 PM

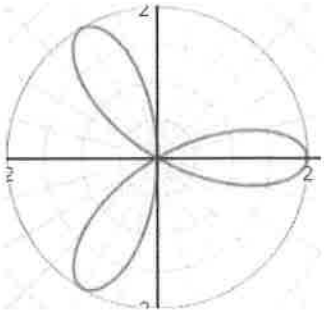
# Rose Petals

$r = a\sin(n\theta)$

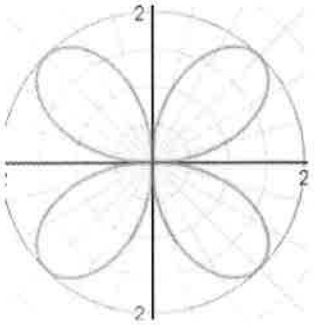


n is odd

$r = a\cos(n\theta)$

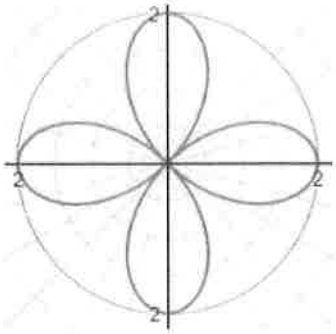


$r = a\sin(n\theta)$



n is even

$r = a\cos(n\theta)$



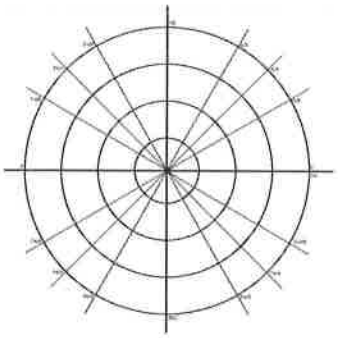
Quick Tips for Graphing Rose Petal Curves

- If n is odd same number of petals
- If n is even double the number of petals
- a is the length of a petal
- Choose four cardinal points and determine the period to aid in choosing points

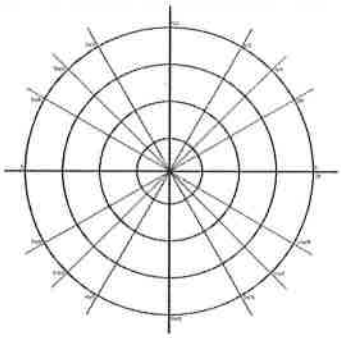
Jun 14-8:06 PM

# Rose Petals

$r = 2\sin(3\theta)$

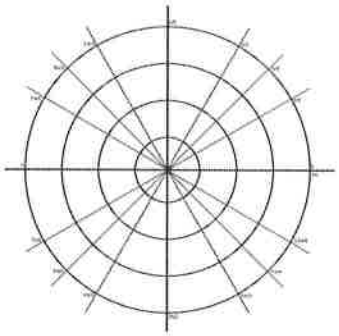


$r = 4\cos(3\theta)$

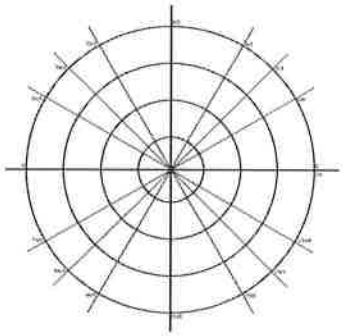


n is odd

$r = 3\sin(2\theta)$



$r = \cos(4\theta)$



n is even

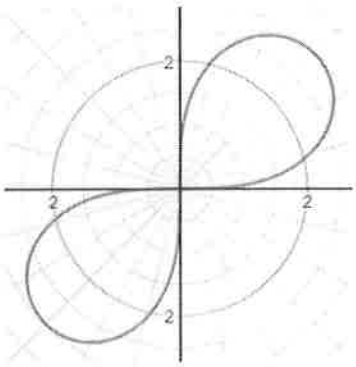
Quick Tips for Graphing Rose Petal Curves

- If n is odd same number of petals
- If n is even double the number of petals
- a is the length of a petal
- Choose four cardinal points and determine the period to aid in choosing points

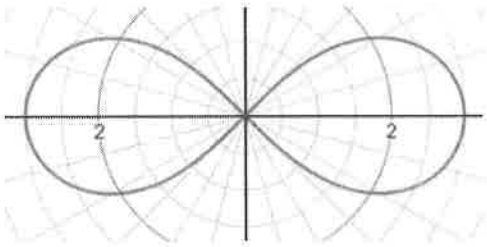
Jun 14-8:06 PM

# Lemniscates

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




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



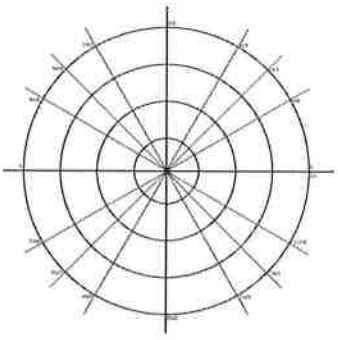

Quick Tips for Graphing Lemniscates

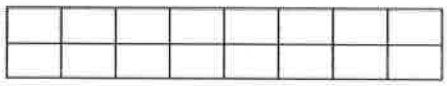
- Cosine graphs are longest along the x axis, this is equivalent to the a value
- Sine graphs are longest along the diagonal, 45 degrees, this is equivalent to the a value

Jun 6-7:56 AM

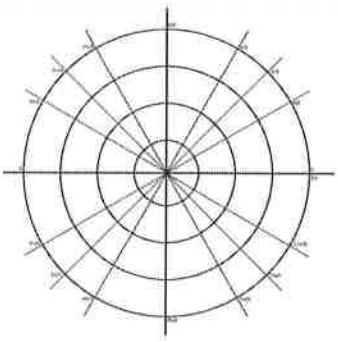
# Lemniscates

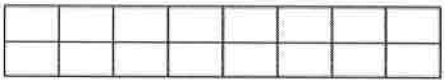
$r^2 = 9\sin(2\theta)$





$r^2 = 4\cos(2\theta)$





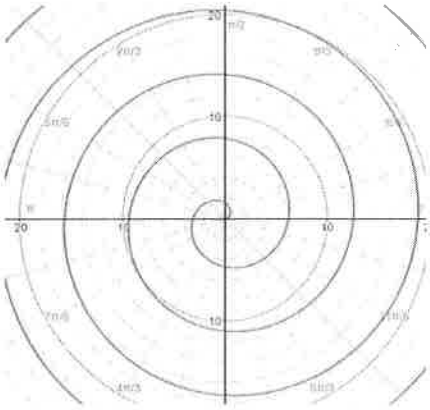
Quick Tips for Graphing Lemniscates

- Cosine graphs are longest along the x axis, this is equivalent to the a value
- Sine graphs are longest along the diagonal, 45 degrees, this is equivalent to the a value

Jun 6-7:56 AM

# Spirals

$$r = \theta$$



Jun 6-7:55 AM