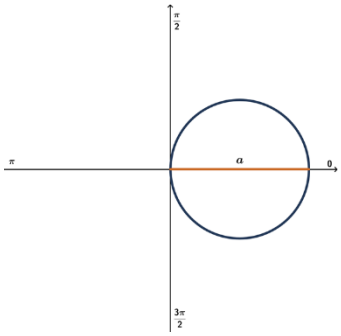
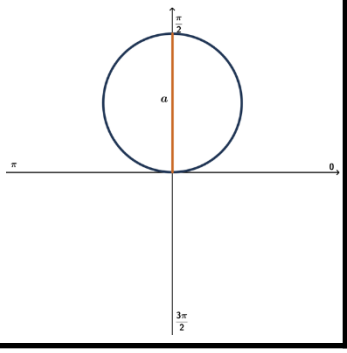
Special Polar Graphs

Circles

$r = a\cos\theta$

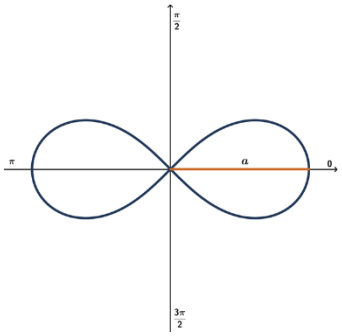


$r = a\sin\theta$

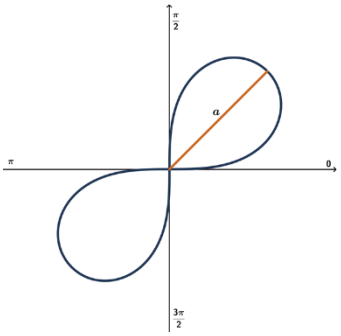


Lemniscates

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

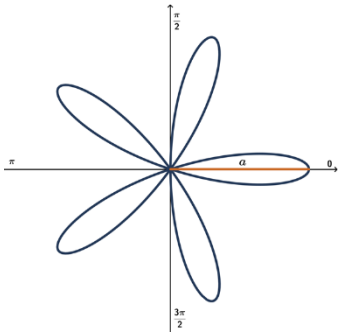


$r^2 = a^2\sin 2\theta$



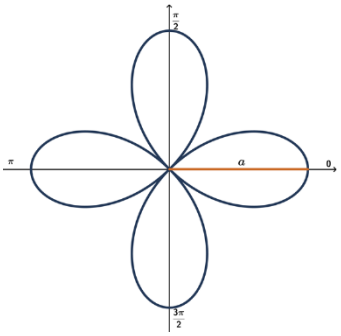
Rose Curves

$r = a\cos n\theta$



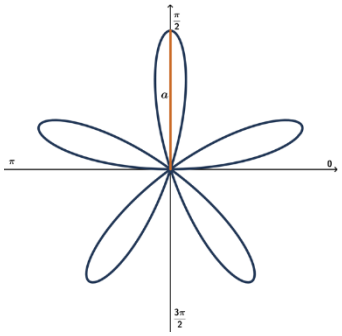
n petals when n is odd, $n \geq 2$

$r = a\cos n\theta$



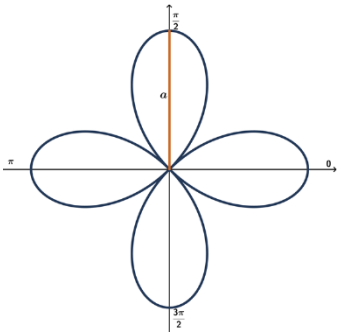
$2n$ petals when n is even, $n \geq 2$

$r = a\sin n\theta$



n petals when n is odd, $n \geq 2$

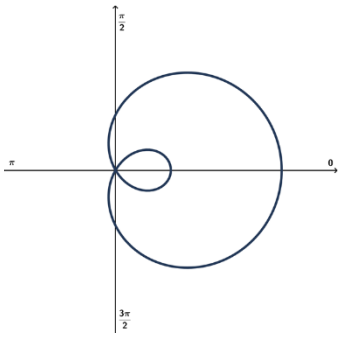
$r = a\sin n\theta$



$2n$ petals when n is even, $n \geq 2$

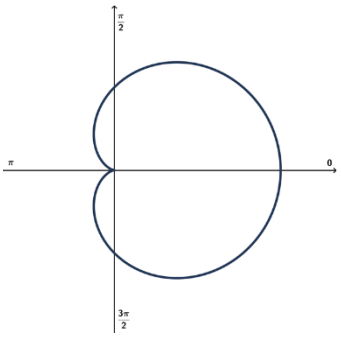
Limaçons

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



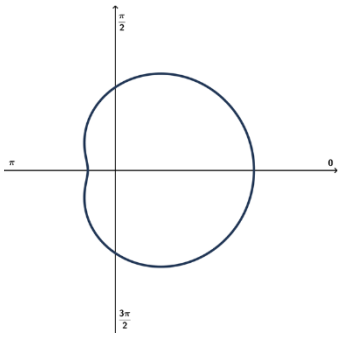
Limaçon with inner loop

$a < b$



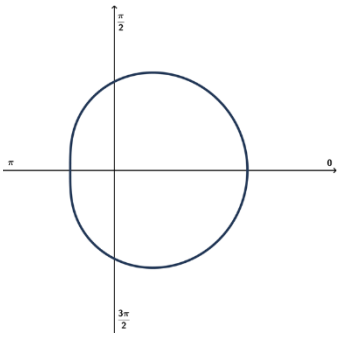
Cardioid

$a = b$



Dimpled limaçon

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



Convex limaçon

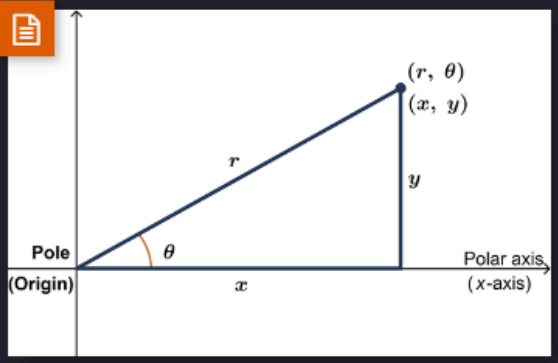
$\frac{a}{b} \geq 2$

Symmetry

If you replace (r, θ) as directed in the table and produce an equivalent equation to the original equation, the graph is symmetric about the specified axis or point.

Axis of Symmetry	Replace (r, θ) with
The polar axis	$(r, -\theta)$ *or* $(-r, \pi - \theta)$
The line $\theta = \frac{\pi}{2}$	$(-r, -\theta)$ *or* $(r, \pi - \theta)$
The pole	$(-r, \theta)$ *or* $(r, \pi + \theta)$

FORMULA



To convert from polar coordinates to rectangular coordinates

$(r, \theta) \rightarrow (x, y)$

$x = r(\cos \theta)$

$y = r(\sin \theta)$

To convert from rectangular coordinates to polar coordinates

$(x, y) \rightarrow (r, \theta)$

$r = \sqrt{x^2 + y^2}$

$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

Eliminating the Parameter

1. Isolate the parameter in one equation.
2. Substitute into the second equation.