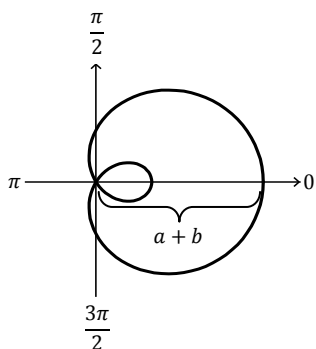


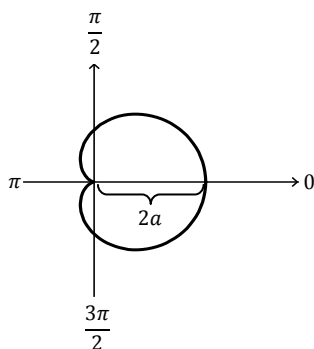
Special Polar Graphs

Limaçons: (positive cosine orientation) period = 2π $r = a \pm b \cos(\theta)$ $r = a \pm b \sin(\theta)$ ($a > 0, b > 0$)



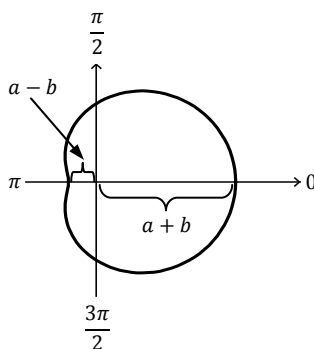
$$\frac{a}{b} < 1$$

Limaçon with inner loop



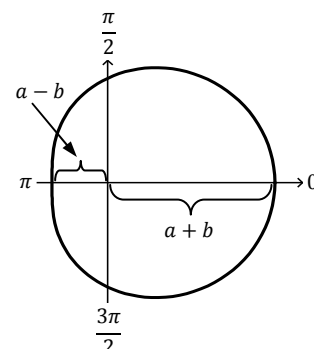
$$\frac{a}{b} = 1$$

Cardioid (heart-shaped)



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

Dimpled limaçon

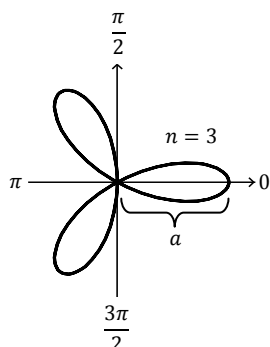


$$\frac{a}{b} \geq 2$$

Convex limaçon

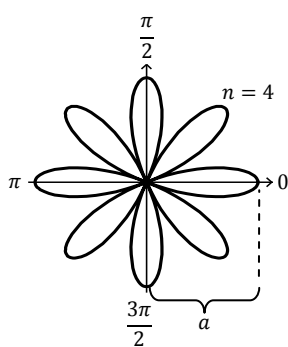
Rose Curves:

n petals if n is odd (period = π); $2n$ petals if n is even ($n \geq 2$ and period = 2π)



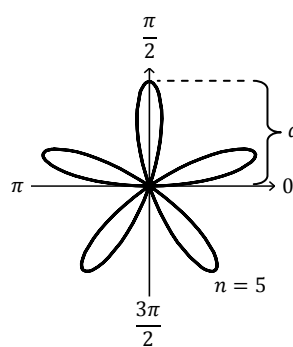
$$r = a \cos(n\theta)$$

Rose curve



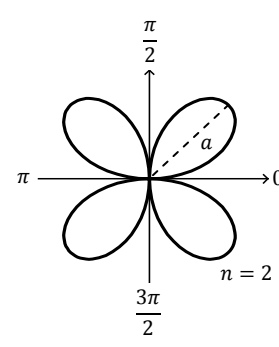
$$r = a \cos(n\theta)$$

Rose curve



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

Rose curve

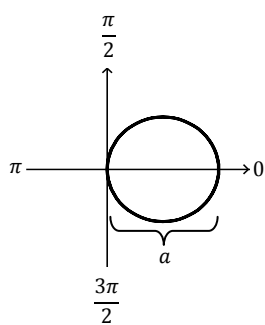


$$r = a \sin(n\theta)$$

Rose curve

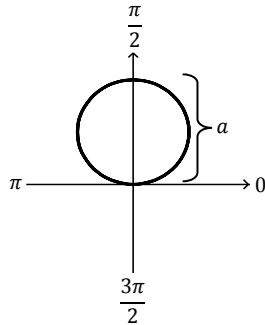
Circles and Lemniscates:

period = π



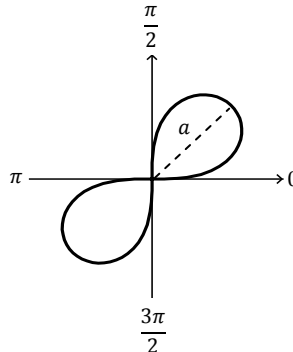
$$r = a \cos(\theta)$$

Circle



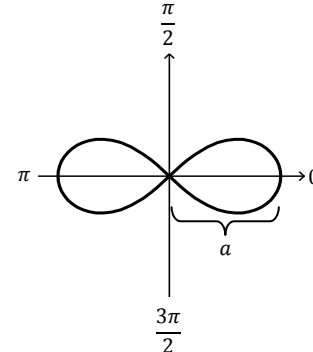
$$r = a \sin(\theta)$$

Circle



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

Lemniscate



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

Lemniscate