

## Conversions

### Rectangular → Polar

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

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

### Polar → Rectangular

$$r^2 = x^2 + y^2$$

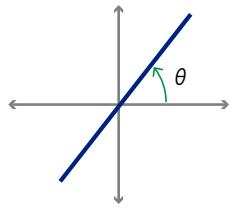
$$\tan(\theta) = \frac{y}{x}$$

## Common Curves

### Lines

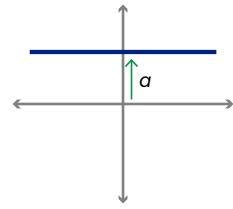
$$\theta = \text{constant}$$

Line through origin



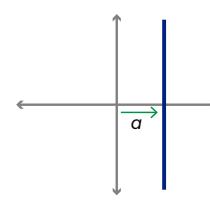
$$r = a \csc(\theta)$$

Horizontal line



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

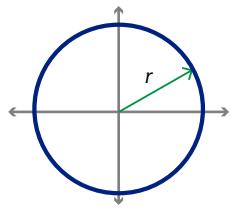
Vertical line



### Circles

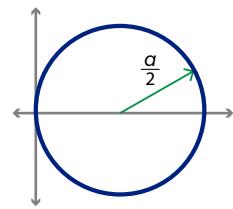
$$r = \text{constant}$$

Circle centered at origin



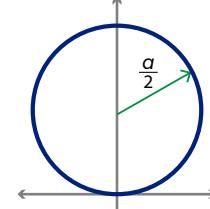
$$r = a \cos(\theta)$$

Circle centered at  $(\frac{a}{2}, 0)$



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

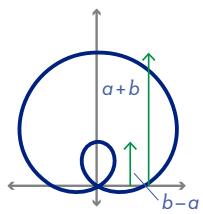
Circle centered at  $(0, \frac{a}{2})$



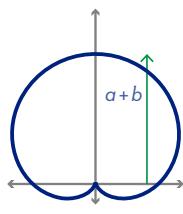
## Limaçon $r = a \pm b \sin(\theta)$

Cosine limaçons extend to the left or right, rather than up or down.

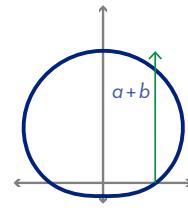
$$a < b$$



$$a = b$$



$$a > b$$

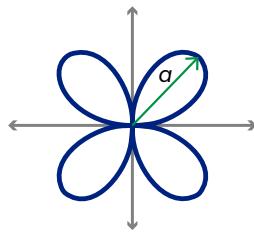


## Rose

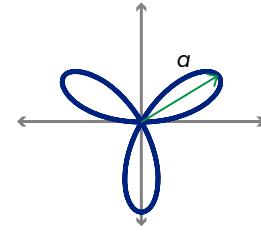
$$r = a \sin(n\theta)$$

- *n even*:  $2n$  petals
- *n odd*:  $n$  petals
- 1st petal starts tangent to the axis

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



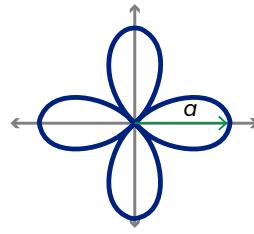
$$r = a \sin(3\theta)$$



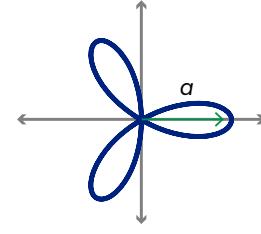
$$r = a \cos(n\theta)$$

- *n even*:  $2n$  petals
- *n odd*:  $n$  petals
- 1st petal starts centered on the axis

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

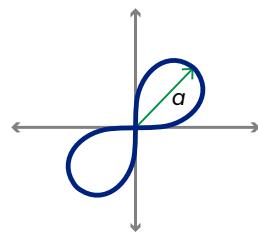


$$r = a \cos(3\theta)$$

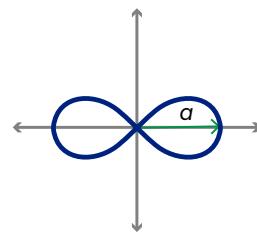


## Lemniscates

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



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



- *sine*: petals aligned  $45^\circ$
- *cosine*: petals on  $x$ -axis