

10.3 - Polar Coordinates

10.3a

Rectangular-polar conversions

$$x = r \cos \theta, y = r \sin \theta, x^2 + y^2 = r^2, \tan \theta = \frac{y}{x}$$

[illegible]

10.3b

Exercises:

Identify the curve by finding a Cartesian equation for the curve.

$$r = 4 \sec \theta$$

$$r^2 \sin 2\theta = 1$$

Find a polar equation for the curve represented by the given Cartesian equation.

$$4y^2 = x$$

10.3c

Common types of polar equations

$$r = a \pm b \sin \theta \text{ (or } \cos \theta \text{)}$$

- Cardioid if $a = b$
 - Dimpled limaçon if $a > b$
 - Limaçon with an inner loop if $a < b$
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$$r = a \sin n\theta \text{ (or } \cos n\theta \text{)}$$

- Rose with n petals if n is odd
 - Rose with $2n$ petals if n is even
 - Circle if $n = 1$
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$$r^2 = a^2 \cos 2\theta \text{ (lemniscate)}$$

10.3d

Testing for symmetry in the polar plane

- With respect to the polar axis: replace $\theta \rightarrow -\theta$
- With respect to the line $\theta = \pi/2$: replace $\theta \rightarrow \pi - \theta$
- With respect to the pole: replace $r \rightarrow -r$ or $\theta \rightarrow \pi + \theta$

Note: Functions involving the sine function are typically symmetric with respect to the line $\theta = \pi/2$, and functions involving the cosine function are typically symmetric with respect to the polar axis.

10.3e

Exercise:

Sketch the curve with the given polar equation by first sketching the graph of r as a function of θ in Cartesian coordinates.

$$r = 1 + 2 \cos \theta$$

10.3f

Exercise:

Use a graphing device to graph the polar curve. Choose the parameter interval to make sure that you produce the entire curve.

$$r = 2 + \cos\left(\frac{9\theta}{4}\right)$$
