

Rotation

Drawing Mathematics with Desmos | Justin Skycak

Setup. Navigate to <https://www.desmos.com/calculator>. Be sure to sign in so that you can save your graph.

Demonstration - Rotation. Observe the graph as you type each of the following inputs. In general, a graph can be rotated by an angle of θ about the origin by replacing x and y with the following expressions:

$$x \rightarrow x \cos \theta + y \sin \theta$$

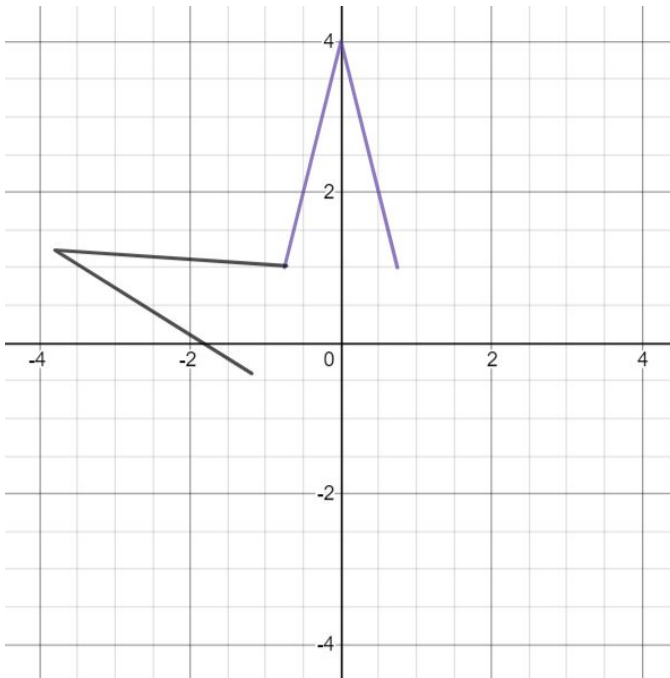
$$y \rightarrow y \cos \theta - x \sin \theta$$

Note that θ should be given in radians, and one can convert degrees to radians by multiplying by the conversion factor $\frac{\pi}{180}$.

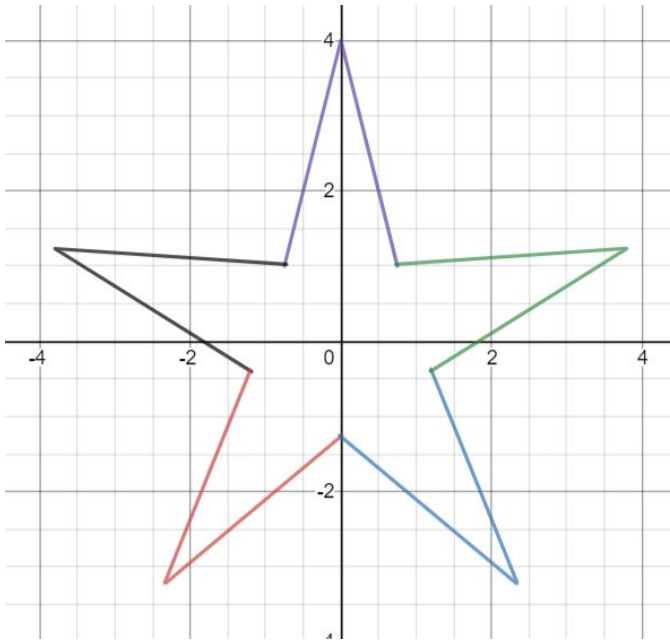
$$y \cos \frac{\pi}{6} - x \sin \frac{\pi}{6} = (x \cos \frac{\pi}{6} + y \sin \frac{\pi}{6})^2$$

$$\left(\frac{x \cos \frac{\pi}{4} + y \sin \frac{\pi}{4}}{4} \right)^2 + \left(\frac{y \cos \frac{\pi}{4} - x \sin \frac{\pi}{4}}{2} \right)^2 = 1$$

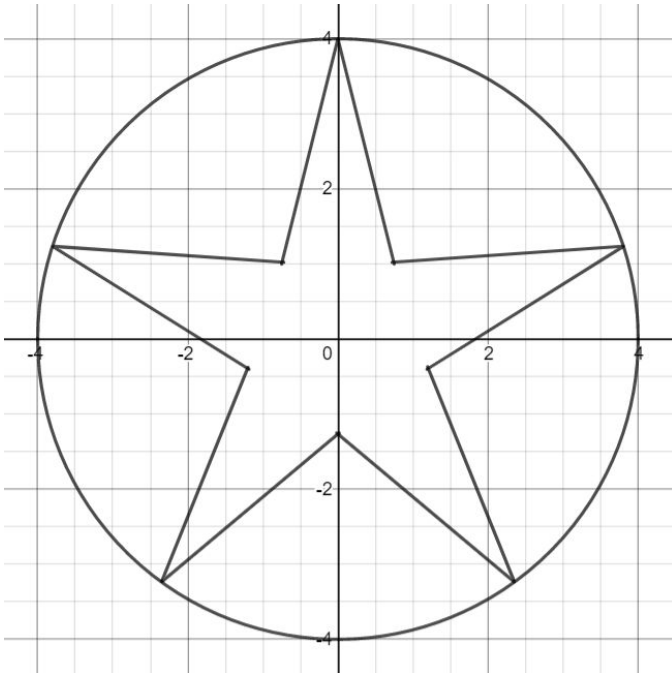
Exercise. Reproduce the graph below by drawing an absolute value function and then rotating it a fifth of a circle counterclockwise.



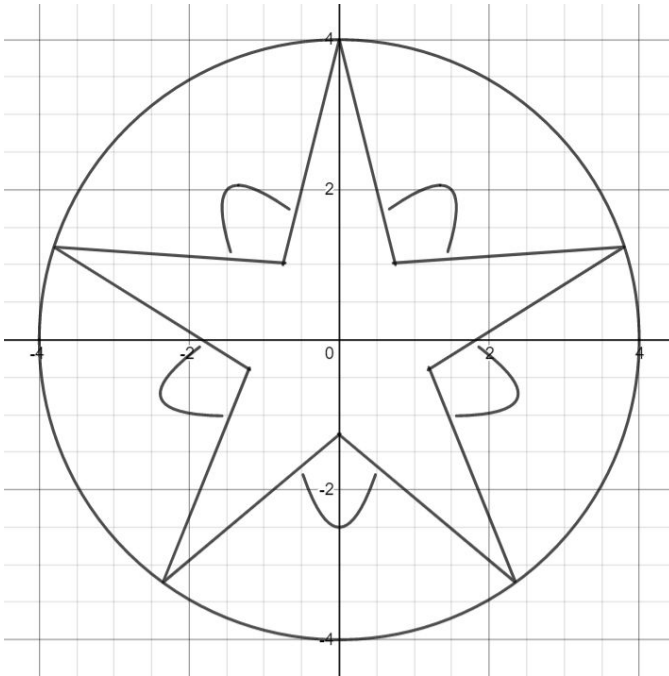
Exercise. Continue drawing rotated absolute value functions to form a star.



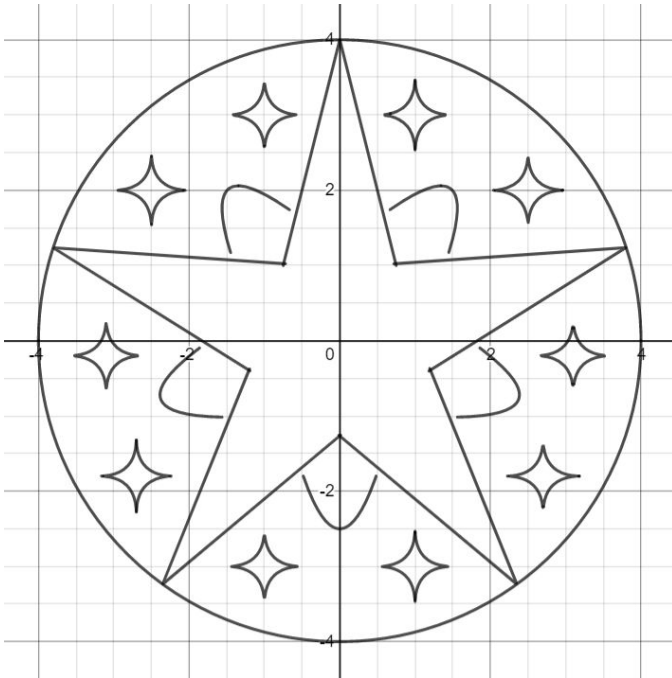
Exercise. Draw a circle which passes through the sharp points of the star.



Exercise. Add a background layer by drawing rotated parabolas.



Exercise. Finally, add non-Euclidean ellipses to the background.



Challenge. Create your own emblem.