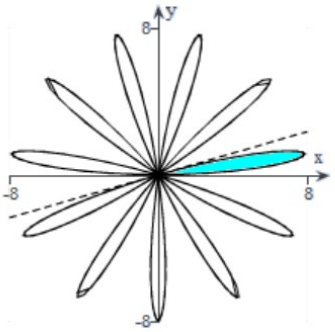
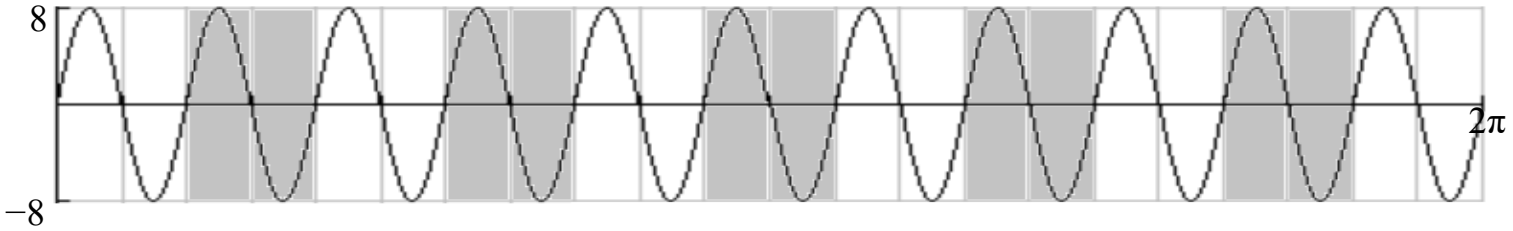
Area of a Polar Rose



Use the area formula $\int_{\alpha}^{\beta} \frac{1}{2} r^2 d\theta$ to find the area of one petal of the rose $r = 8\sin 11\theta$ shown to the right. Hint: The first petal starts and ends when $r = f(\theta) = 8\sin 11\theta = 0$.

The graph of $r = 8\sin 11\theta$ has ___ complete cycles in the interval $0 \le \theta \le 2\pi$.



1. To find the integration limits, we can find values $\theta = \alpha$ and $\theta = \beta$ for which $r = 8\sin 11\theta = 0$, since this will be where the first petal starts and ends. The graph starts at $\alpha = 0$. Find β for which the graph of $r = 9 \sin 11\theta = 0$.

$\beta =$ _____. (Report β as an exact value involving π.)

TIP: The dashed line in the above graph is the polar equation $\theta = \beta$. You can enter in your polar grapher $r = 9 \sin 11\theta$ and θmin = 0 and θmax = β to check that you have sketched only the first petal.

2. The exact area is $\int_{0}^{\beta} \frac{1}{2} r^2 d\theta$ = _____ (Write as a multiple of π. Use FNINT)