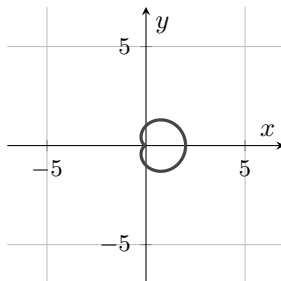
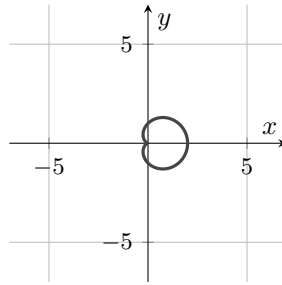


Question 1**Problem**

Find the length of the cardioid $r = 1 + \cos \theta$.



Question 1 – Solution**Solution**

1. Differentiate the polar radius to obtain $r' = dr/d\theta$ and choose an interval that traces the requested arc exactly once.
2. Use the polar arc-length formula

$$L = \int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} d\theta.$$

Simplify the expression under the square root before evaluating or reporting the integral.

3. The speed simplifies to $2|\cos(\theta/2)|$.
4. Integrating from 0 to 2π gives 8.