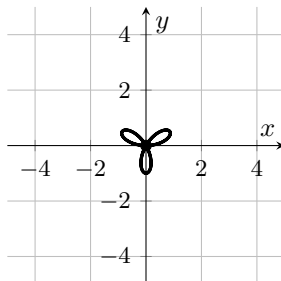
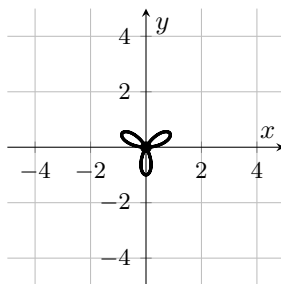


**Question 9****Problem**

A student cancels  $r$  before using the polar slope formula at a pole. Explain the danger.



## Question 9 – Solution



## Solution

1. Write the polar curve parametrically as

$$x(\theta) = r(\theta) \cos \theta, \quad y(\theta) = r(\theta) \sin \theta.$$

Differentiation gives

$$\frac{dx}{d\theta} = r' \cos \theta - r \sin \theta, \quad \frac{dy}{d\theta} = r' \sin \theta + r \cos \theta.$$

2. Wherever  $dx/d\theta \neq 0$ , compute

$$\frac{dy}{dx} = \frac{r' \sin \theta + r \cos \theta}{r' \cos \theta - r \sin \theta}.$$

Test numerator and denominator separately when locating horizontal or vertical tangents.

3. At  $r = 0$ , direct division by  $r$  is undefined. Valid cancellation where  $r \neq 0$  can help compute a limit, but does not by itself justify substitution at the pole.
4. One must use a limit or inspect the parameter values producing the pole.