10-1 Lengths of Curves

Learning Objectives:

I can find the length of A parametrically defined curve

Length of a Parametric Curve

Let L be the length of a parametric curve that is traversed once as t increases from t_1 to t_2, the:

$$\int_{t_1}^{t_2} \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$$

if $\frac{dx}{dt}$ & $\frac{dy}{dt}$ are continuous functions.

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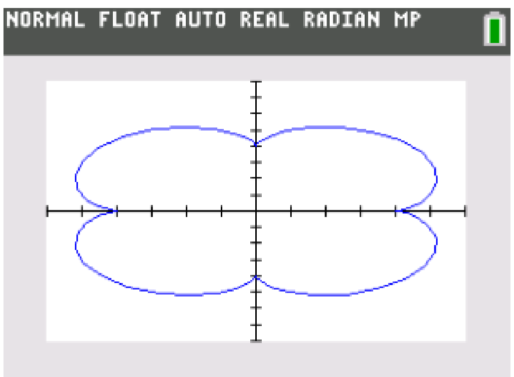
Ex1. Find the length of the curve

1.) $x = 5\cos(t) - \cos(5t)$

$y = 5\sin(t) - \sin(5t)$



find the length of the curve

$x = 5\cos(t) - \cos(5t) \rightarrow \frac{dx}{dt} = -5\sin(t) + 5\sin(5t)$

$y = 5\sin(t) - \sin(5t) \rightarrow \frac{dy}{dt} = 5\cos(t) - 5\cos(5t)$

$$\int_0^{2\pi} \sqrt{(-5\sin t + 5\sin(5t))^2 + (5\cos(t) - 5\cos(5t))^2}\, dt = 40$$

2.) $x = t^2$ $y = 2t$ $0 \le t \le 2$

$$\frac{dx}{dt} = 2t \quad \frac{dy}{dt} = 2$$

$$\int_0^2 \sqrt{(2t)^2 + (2)^2} \cdot dt = 5.916$$

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Homework

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