

Given a relation defined by the parameters $x(t)$ and $y(t)$:

Derivatives

1st Derivative

$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$$

2nd Derivative

$$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt} \frac{dy}{dx}}{\frac{dx}{dt}}$$

Arc Length

$$s = \int_a^b \sqrt{[x'(t)]^2 + [y'(t)]^2} dt$$

Area of a Surface of Revolution

Revolve around x -axis

$$s = 2\pi \int_a^b y(t) \sqrt{[x'(t)]^2 + [y'(t)]^2} dt$$

Revolve around y -axis

$$s = 2\pi \int_a^b x(t) \sqrt{[x'(t)]^2 + [y'(t)]^2} dt$$