Formulae

Area under the parametric curve $x = f(t), y = g(t)$ traversed once as t increases from α to β

$$A = \int_{\alpha}^{\beta} g(t)f'(t)\ dt$$

Length of the parametric curve $x = f(t), y = g(t)$ traversed once as t increases from α to β

$$L = \int_{\alpha}^{\beta} \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\ dt$$

Surface area of the parametric curve $x = f(t), y = g(t)$ traversed once as t increases from α to β, rotated about the x-axis

$$S = \int_{\alpha}^{\beta} 2\pi y \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\ dt$$

Area of the polar curve $r = f(\theta)$ from a to b

$$A = \int_{a}^{b} \frac{1}{2} r^2\ d\theta$$

Arc length of the polar curve $r = f(\theta)$ from a to b

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

Conic sections

$$r = \frac{ed}{1 \pm e\cos\theta} \quad or \quad r = \frac{ed}{1 \pm e\sin\theta}$$

is an ellipse if $e < 1$, a parabola if $e = 1$, or a hyperbola if $e > 1$