Formula Sheet

Parametric Equations:

$$x = f(t), \quad y = g(t), \quad \alpha \leq t \leq \beta$$

Slope of a tangent line:

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{g'(t)}{f'(t)}$$

Area:

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

Arclength:

$$\int_{\alpha}^{\beta} \sqrt{(f'(t))^2 + (g'(t))^2}dt$$

Surface area:

$$\int_{\alpha}^{\beta} 2\pi g(t)\sqrt{(f'(t))^2 + (g'(t))^2}dt$$

Polar Equations:

$$r = f(\theta), \quad \alpha \leq \theta \leq \beta$$

Polar coordinates to cartesian:

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

Cartesian coordinates to polar:

$$r = \sqrt{x^2 + y^2}, \qquad \theta = \arctan\left(\frac{y}{x}\right)$$

Slope of a tangent line:

$$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{f'(\theta)\sin(\theta) + f(\theta)\cos(\theta)}{f'(\theta)\cos(\theta) - f(\theta)\sin(\theta)}$$

Area:

$$\int_{\alpha}^{\beta} \frac{1}{2}(f(\theta))^2 d\theta$$

Arclength:

$$\int_{\alpha}^{\beta} \sqrt{(f'(\theta))^2 + (f(\theta))^2}d\theta$$